Southern California Priority Corridor
Showcase Program Evaluation

Summary Evaluation Report

FINAL

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Abbreviations & Acronyms

ATIS	Advanced Traveler Information System
ATMS	Advanced Transportation Management System
ATMSi	Advanced Transportation Management System - Intermodal
AVL	Automatic Vehicle Location
Caltrans	California Department of Transportation
CCTV	Closed-circuit Television surveillance camera
CHP	California Highway Patrol
CM	Configuration Management
CMP	Configuration Management Plan
CMS	Changeable Message Sign
CONOPS	Concept of Operations
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-the-Shelf
CTC	California Transportation Commission
CVO	Commercial Vehicle Operations
CW	Corridor-wide
CWATIS	Corridor-wide Advanced Traveler Information System Project
CWATMS	Corridor-wide Advanced Transportation Management System Project
CWCVO	Corridor-wide Commercial Vehicle Operations Project
CWSIP	Corridor-wide Systems Integration Project
CWSPP	Corridor-wide Strategic Planning Project
DOD	U.S. Department of Defense
DOF	California Department of Finance
DOIT	California Department of Information Technology
DOJ	Department of Justice
DOT	Department of Transportation
DRI	Caltrans Division of Research & Innovation (formerly NTR)
EAP	Evaluation Activity Plan
EP	Evaluation Plan
FHWA	Federal Highway Administration
FSP	Freeway Service Patrol
FSR	Feasibility Study Report
FTA	Federal Transit Administration
FTE	Full-Time Equivalent (one full-time employee)
GPRA	Government Performance Reporting Act
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HAT	Highway Advisory Telephone
HP	Hewlett-Packard
HQIT	Headquarters - Information Technology (Division of Caltrans)
IDL	Interface Definition Language (CORBA term)
IMTMC/S	Intermodal Transportation Management Center/System
IPP	Implementation Phasing Plan
IPR	Intellectual Property Rights
ISSC	Information Systems Service Center (division of Caltrans)

ISTEA	Intermodal Surface Transportation Efficiency Act (of 1991)
ITS	Intelligent Transportation Systems (formerly IVHS)
IVHS	Intelligent Vehicle & Highway Systems (now ITS)
IWS	Integrated Workstation
JPO	Joint Program Office (within U.S. DOT)
JPA	Joint Powers Authority
LACDPW	Los Angeles County Department of Public Works
LADOT	City of Los Angeles Department of Transportation
LAN	Local Area Network
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
MTA	Los Angeles County Metropolitan Transportation Authority
MTBF	Mean Time Between Failure
MTDB	Metropolitan Transit Development Board (San Diego County)
MVEM	Mission Valley Event Management System (a.k.a. Mission Valley ATMIS)
NCTD	North County Transit District (San Diego County)
NDA	Non-Disclosure Agreement
NET	National Engineering Technology Corporation
NTCIP	National Transportation Communications for ITS Protocol
NTR	Caltrans Division of New Technology & Research (now DRI)
OCMDI	Orange County Model Deployment Initiative
OCTA	Orange County Transportation Authority
O&M	Operations and Maintenance
OMM	Operations & Maintenance Model
OS	Operating system (such as Windows™, Unix, Linux, et. al.)
PC	Personal Computer (Windows™-based)
RAMS	Regional Arterial Management System
RAVL	Regional Automatic Vehicle Location
RCTC	Riverside County Transportation Commission
RFP	Request for Proposals
RTMS	Regional Transit Management System
RTP	Regional Transportation Plan
RTPA	Regional Transportation Planning Agency
RWS	Remote Workstation
SANBAG	San Bernardino Association of Governments
SANDAG	San Diego Association of Governments
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCPCSC	Southern California Priority Corridor Steering Committee
SETA	Systems Engineering & Technical Analysis
SOW	Statement of Work
TANN	Traveler Advisory News Network
TAS	Technical Advisory Subcommittee
TEA-21	Transportation Equity Act for the 21st Century
TMC	Transportation Management Center
TMS	Technical Management Subcommittee
TMT	Traffic Management Team
USDOT	United States Department of Transportation

VDS	Vehicle Detector Station
VOS	Volume/Occupancy/Speed
VCTC	Ventura County Transportation Commission
WAN	Wide Area Network

Executive Summary

Purpose

As required by federal law, all Intelligent Transportation System (ITS) projects that receive federal funding must undergo an evaluation to help assess the costs and benefits of ITS. This document is one of 23 reports produced as part of the Southern California ITS Priority Corridor Showcase Program Evaluation to help planners and decision-makers at the federal, state and local levels make better-informed decisions regarding future ITS deployments. This report summarizes the experiences, costs, and lessons learned from the 17 ITS projects funded through the Southern California Priority Corridor Showcase Program.

Background

In 1993, the U.S. Department of Transportation designated Southern California as one of four Priority Corridors in which ITS could have particular benefit. Southern California suffers from extreme traffic congestion, limited room for expanding transportation facilities, and above-average air pollution levels. The Southern California Priority Corridor is also one of the most populated, most traveled, and most visited parts of the country. In terms of transportation planning, it consists of four separate and adjoining regions:

- ‣ Los Angeles County and portions of Ventura County
- ‣ Orange County
- ‣ San Diego County
- ‣ Inland Empire (San Bernardino and Riverside Counties)

The ITS Showcase Program is one of several programs implemented in Southern California's Priority Corridor to help aid mobility and mitigate traffic congestion and its associated environmental impacts. The Showcase Program consists of 17 ITS projects that collectively form a Corridor-wide intermodal transportation management and information network between Los Angeles, Orange County, San Diego, and the Inland Empire. Each Showcase project deploys a piece of this Corridor-wide ITS network, including regional Advanced Traveler Information Systems (ATIS), regional Advanced Transportation Management Systems (ATMS), and regional and inter-regional communications infrastructure. Eleven of the projects are specific to a particular region, while the remaining six provide Corridor-wide services and inter-regional infrastructure.

Each project was evaluated based on a common set of measures, which address the system development process and resulting system reliability, capital and O&M costs, institutional issues and impacts, user acceptance and system utilization, and transportation system impacts. The findings have been documented in individual project evaluation reports and five summary cross-cutting reports. Program-level evaluation findings have been drawn from these sources and are presented below.

Evaluation Findings, Conclusions, and Recommendations

General Findings

The Showcase Program is a very ambitious undertaking, and is only one part of Southern California's ongoing effort to develop and deploy an integrated ITS infrastructure. The Showcase Program has provided Southern California's four regions with a common foundation on which to continue those ITS developments.

Although the goal of the Showcase Program was to develop an integrated, Corridor-wide "system of systems," a number of institutional, programmatic and technical issues have delayed the realization of that goal. These issues are discussed in the more detailed findings below. In the short- to mid-term, the four regions of the Southern California Priority Corridor are pursuing the development of their own separate regional ITS networks, each based upon the Showcase Architecture. These regional ITS networks provide for local integration and coordination, and, in time, may be linked via an inter-regional backbone to ultimately achieve the Corridor-wide vision.

Findings with Regard to Evaluation Goal 1: System Development and Performance

A number of lessons have been learned through the Showcase Program experience in regards to system development practices and the resulting performance (reliability and availability) of the deployed systems. These lessons, as well as recommendations by the evaluation, include:

‣ Agencies should consider the benefits of using an independent, high-level System Engineering & Technical Analysis (SETA) consultant to help design, estimate, and oversee their large-scale technology programs. In the case of Showcase, there was no single agency, consultant, or group responsible for handling the technical details of "the big picture." Such a consultant would have been beneficial to help plan, coordinate, oversee, and report on the many concurrent projects.

‣ In general, the Showcase projects started with overly aggressive 1-2 year schedules. Consensus building and document reviews during the development of requirements and high-level design took each project as much as 18-24 months. Based on the Showcase projects, and other ITS projects nationwide, it is more realistic to expect a typical ITS project to take 4-5 years to complete.

‣ Agencies should consider requiring that system documentation – especially system designs and interface specifications – conform to an established industry standard in order to help ensure their quality and completeness. This is one step towards helping to guarantee that the designs and specifications are truly "open" and that no contractor or vendor is creating a competitive advantage by withholding information.

‣ Developing custom software and integrating systems – especially between agencies – are difficult tasks that should not be underestimated. There is always risk when developing custom software, and surprises should always be expected. Utilizing smaller, more focused projects – and proceeding in smaller steps – will help minimize the complexity and risk.

▸ Agencies should consider the pros and cons of splitting the Design and Implementation phases of technology projects into separate contracts or task orders. By splitting the Design and Implementation phases, agencies gain more flexibility and are better able to define the end product and estimate its costs before committing resources to build it. This will also help reduce risk to consultants when performing under fixed-price contracts. Of course, splitting the project will require an additional contracting cycle that could induce delay. The agency must balance the potential benefits against that possible delay.

▸ The first step in any ITS project should be the development of a detailed Concept of Operations (ConOps), which helps create a shared project vision by clearly defining the intended functionality of the system and the anticipated roles and responsibilities of the end users. Early development of a ConOps – perhaps during a Planning or Design phase – could help reveal any institutional, procedural, financial or legal issues before the system implementation begins.

▸ Obtain the buy-in and participation of Operations staff throughout the project. ITS projects are most often conceived by Planners who envision more efficient and innovative ways to help manage the transportation system; however, it is the Operations staff who must ultimately adopt and use these new tools if they are to reach their full potential. Planners must work closely with Operations staff (e.g., TMC and Dispatch Center staff) throughout the project to ensure that the proposed system will fit within the procedural and financial limits of the agencies involved.

Findings with Regard to Evaluation Goal 2: Costs

▸ One of the credos of the Showcase Program was "Design Once, Deploy Many Times," which seeks system standardization, program efficiency and cost savings through software reuse. There are clear examples of software reuse within individual projects (such as TravelTIP) and between projects awarded to the same contractor. In fact, one of the Showcase Program's greatest accomplishments was the development of its system interface standards, which allow developers to use a "black box" approach to independently design and build interoperable systems. As long as new systems conform to the standard interfaces, they should be able to work together and with other "Showcase-compliant" systems without having to reveal the details of their inner workings. This protects a contractor's intellectual property rights while supporting the goal of "Design Once, Deploy Many Times."

▸ From a cost perspective, the Showcase Program carried out its objectives within the allotted budget. Actual funds expended by agencies to complete the projects remained within 0.02 percent of initial Program funding despite Showcase's long duration. For several projects that experienced time delays – such as Rideshare, IMAJINE, and LA/Ventura ATIS – budgets were not impacted due to the use of firm fixed price contracts. Two exceptions were InterCAD and the Fontana-Ontario ATMIS project in which excess funds were utilized to complete or enhance the original project.

▸ To aid in the adoption of the new technologies, most Showcase projects provided initial training and demonstrations to familiarize agency staff (operators and system maintainers)

with their system's full range of capabilities. Ongoing training for new operators will be provided on-the-job by the agencies themselves. However, by design, users with general computer skills can operate Showcase-developed workstations. The workstations have an intuitive Windows™-like user interface, which also reduces the need to hire more expensive labor.

Findings with Regard to Evaluation Goal 3: Institutional Impacts

▶ Projects and systems must conform to existing agency policies if they want to succeed. The Showcase Program has shown that agencies will not change their policies just to accommodate a new project or system. The policies are designed to protect the agency and its staff, and the project must abide by them.

▶ Some ITS investments will impose new roles and responsibilities on some agency partners. In order to help these agency partners adapt to these new responsibilities and continue using the system after the project is complete, the lead or sponsor agency should consider providing follow-up calls, visits, or even additional training. Such follow-ups are necessary until users adopt the system and it becomes "institutionalized."

▶ The smaller agencies (typically without full-time staffed TMCs) rely on systems that run autonomously and perform the majority of their functions without much human intervention. With regards to traveler information systems, the smaller agencies tend to post incident advisories only in major cases, and then only when someone is available to do so. In some cases, these agencies assign the duty of entering incident information to student interns, with oversight from a full-time traffic engineer.

▶ One of the Showcase Program's greatest achievements was the development of its own system architecture and interface standards for the entire Southern California Priority Corridor. The Showcase systems' software is based on an object-oriented design that utilizes a number of standardized classes, including a Control Center object, Vehicle Detector Station (VDS) object, CCTV camera object, etc. The Common Object Request Broker Architecture (CORBA) is used to make objects at one center accessible from another center. The Showcase standard describes these objects and their interfaces using Unified Modeling Language (UML) class diagrams and CORBA's Interface Definition Language (IDL).

Possession and understanding of the complete object definitions and IDL is necessary, but not necessarily sufficient, to enable the future implementation and addition of new centers to the Showcase Network. These object definitions and IDL currently can only be found in the various design documents for the regional projects and the Kernel. A review task is needed to consolidate the information and verify its accuracy and completeness in describing the Showcase systems as built.

▶ With the completion of the Showcase Program, the Priority Corridor Steering Committee will not dissolve, but continue to meet in a new role. The Steering Committee is a unique body that draws together agencies from across all of Southern California to discuss and coordinate on ITS issues. No other body in the State of California brings together so many

agencies and stakeholders. As a result, this body will transition and be mainstreamed from the Program's Steering Committee to the "Southern California ITS Forum."

‣ The Showcase Program provided seed funding for the Traveler Advisory News Network (TANN), a semi-private traveler information provider and data broker. The Southern California Association of Governments (SCAG) helped create TANN to support and streamline the traveler information market in Southern California. TANN has been successful in increasing the distribution of traveler information by providing it to established media outlets such as television stations and local area news websites. TANN reported that "page views" of its maps had reached 3 million per month (nationwide, but mostly in Southern California) by June 2003. This was aided a great deal by its partnership with the ABC television affiliate in Los Angeles.

Findings with Regard to Evaluation Goal 4: Transportation/Traveler Information Management

‣ Although inter-regional integration (between regions) has not yet been achieved in the Southern California Priority Corridor, the Showcase Program projects have integrated a large number of agency systems within each region. The Los Angeles-Ventura and San Diego regions are each pursuing the development of their own regional ITS networks based on the architecture and standard interfaces developed by the Showcase Program. Because the systems in the four regions are all based on the same Showcase Architecture and interface standards, they are well positioned for eventual Corridor-wide integration.

‣ Many agencies – particularly those new to ITS – do not have the staff resources to manually operate a system (for example, to post an advisory on a CMS or traveler information website) on a full-time basis. As a result, and where possible, systems should be designed to run and perform the majority of their functions automatically. Those that require human intervention will tend to be underutilized.

‣ Showcase's online traveler information systems provide valuable information to the traveling public, but are generally underutilized by commuters. As a result, macro-level analyses of historical traffic data show no before-and-after impacts to overall traffic conditions. 87% of the respondents to a TANN User Survey conducted by the Volpe Center in coordination with the Showcase Evaluation reported that the system has saved them travel time, although highway statistics from Caltrans and California's Partnership for Advanced Transit and Highways (PATH) do not show clear evidence of any aggregate, network-wide savings or improvements. Focus group interviews with traveler information users revealed that only a handful of users actively seek out traveler information sources without being prompted by marketing. This suggests that a small number of highly motivated commuters currently benefit from the systems, but this number of commuters is too small to noticeably impact overall traffic conditions. To achieve market penetration to an extent that might noticeably impact traffic conditions, agencies must continue to actively market their traveler information services or outsource such services to a private entity such as the Traveler Advisory News Network (TANN).

Findings with Regard to Evaluation Goal 5: Transportation System Impacts

▸ For several of the Showcase projects, an evaluation of transportation system impacts was deemed unwarranted due to observed low or insignificant usage of the deployed ITS. It was not feasible to measure their impact on travel adjustments (by time of day and route), mode shifts, traffic safety, or air quality in a comprehensive and scientifically robust cost/benefit manner because they had not sufficiently penetrated the traveler information marketplace. In short, for most of the systems, it is too early to tell what the impacts might be. These treatments must be given more time to work. A more thorough impacts analysis of these systems might be warranted once greater usage is achieved.

Conclusion

As described by the preceding findings, the Southern California Priority Corridor has learned and accomplished a tremendous amount in the past ten years. Although the four regions are currently developing their own separate regional ITS networks, these efforts are all based on the same Corridor-wide architecture and interface standards developed during the Showcase Program. As a result, the intra-regional integration efforts are benefiting by having more compatible systems, and the Priority Corridor remains well positioned for eventual inter-regional integration.

1 Introduction

1.1 Purpose and Scope of this Report

As required by federal law[1], all Intelligent Transportation System (ITS) projects that receive federal funding must undergo an evaluation to help assess the costs and benefits of ITS. The information provided in this report is intended to help planners and decision-makers at the federal, state and local levels make better-informed decisions regarding future ITS deployments based on the combined experiences of Southern California's Showcase Program projects.

This document is one of 23 reports produced as part of the Southern California Priority Corridor ITS Showcase Program Evaluation, and summarizes the findings from the evaluation as a whole. The complete set of findings from the Showcase Program Evaluation are found in the following collection of documents:

Document Type/Title	Date	Document Number
17 Individual Project Evaluation Reports		
Corridor-wide ATIS Project Report	7/16/2003	65A0030/0033
Corridor-wide ATMS Project Report	10/28/2004	65A0030/0049
Corridor-wide CVO Project Report	10/29/2004	65A0030/0051
Corridor-wide Rideshare Project Report	11/1/2004	65A0030/0048
Corridor-wide Strategic Planning Project Report	10/29/2002	65A0030/0028
Fontana-Ontario ATMIS Project Report	11/30/2004	65A0030/0047
IMAJINE Project Report	3/17/2003	65A0030/0029
IMTMC Project Report	11/24/2004	65A0030/0054
InterCAD Project Report	4/2/2003	65A0030/0030
Kernel Project Report	5/30/2003	65A0030/0031
LA ATIS Project Report	3/15/2004	65A0030/0038
Mission Valley ATMIS Project Report	11/12/2004	65A0030/0050
Mode Shift Project Report	10/28/2004	65A0030/0052
OCMDI Project Report	2/20/2004	65A0030/0040
Traffic Signal Integration Project Report	11/23/2004	65A0030/0055
Transit Mgt System Project Report	11/30/2004	65A0030/0053
TravelTIP Project Report	2/16/2004	65A0030/0036
5 Cross-Cutting Evaluation Reports		
System Performance Cross-Cutting Report	11/30/2004	65A0030/0056
Costs Cross-Cutting Report	11/30/2004	65A0030/0057
Institutional Issues Cross-Cutting Report	11/30/2004	65A0030/0058
Information Management Cross-Cutting Report	11/30/2004	65A0030/0059
Transportation System Impacts Cross-Cutting Report	11/30/2004	65A0030/0060
Summary Evaluation Reports		
Interim Evaluation Summary Report	6/30/2003	65A0030/0037
Evaluation Summary Report	**11/30/2004**	**65A0030/0061**

1.2   Evaluation Design and Approach

The findings outlined in this report are based on over six years of personal observations at project meetings, reviews of released project documents and agency memos, analysis of quantitative data, as well as formal and informal interviews and discussions with project partners.

The Showcase Program Evaluation Design is based on a set of evaluation Goals and supporting Objectives and Measures that were documented in the "Showcase Program Evaluation Strategy" in December 1997. Each individual Showcase project was evaluated based on an applicable subset of these Goals, Objectives, and Measures in order to help ensure that summary evaluation results could be aggregated from across the multiple Showcase project evaluations. The Showcase Program's five evaluation Goals include:

- ‣ Evaluate System Performance

- ‣ Evaluate Costs

- ‣ Evaluate Institutional Issues and Impacts

- ‣ Evaluate the Use and Management of Transportation/Traveler Information

- ‣ Evaluate Transportation System Impacts

As each project evolved, project-specific refinements to the evaluation design were documented in a high-level Evaluation Plan (EP) and a detailed Evaluation Activity Plan (EAP). In general, the EP describes the project and/or system under evaluation, and lays the foundation for further evaluation activities by developing consensus among the Priority Corridor's Evaluation Subcommittee and project partners as to which of Showcase's evaluation Goals, Objectives, and Measures best apply to that particular project.

As each project matured, and after its EP had been approved, an EAP was developed to plan, schedule, and describe specific activities (interviews, surveys, etc.) and step-by-step procedures for conducting the evaluation. Data collection began after both plans had been reviewed and subsequently approved by the Evaluation Subcommittee and the respective project's partners.

In addition to this Summary Report, evaluation results are documented in 17 individual project evaluation reports and a set of five cross-cutting evaluation reports. Each cross-cutting report addresses one of the five evaluation goals and aggregates goal-specific findings from across all 17 Showcase projects.

1.3   Privacy Considerations

Some of the information acquired in the interview and discussion process could be considered sensitive and has been characterized in this report without attribution. The Evaluation Team has taken precautions to safeguard responses and maintain their confidentiality. Wherever possible, interview responses have been aggregated during analysis such that individual responses have become part of a larger aggregate response. The names of individuals and directly attributable quotes have not been used in this document unless the person has reviewed and expressly consented to its use.

1.4   Constraints & Assumptions

The evaluation is subject to the following constraints and assumptions:

‣ Showcase project consultants were not required to disclose actual project expenses, so each project's cost is based on the fixed-price budget stipulated in its respective contract and any amendments. The budget reflects the expenses and costs for services paid by the client agency, but not necessarily the actual cost to the contractor to complete the project.

2 Background

This chapter describes the geo-political landscape of Southern California, and provides a brief historical perspective of the federal ITS Priority Corridors Program and the beginnings of the Southern California ITS Showcase Program.

2.1 *Southern California*

"Southern California" generally refers to the portion of the state that includes the counties of Los Angeles, Ventura, Orange, San Bernardino, Riverside, San Diego and Imperial. Roughly two-thirds of the state's population – about 20 million people – resides in this area.

Exhibit 1 – Population and Number of Registered Vehicles by County

County	Population[2] (as of 1/1/2003)	Registered Vehicles[3]* (as of 12/31/2002)
Los Angeles	10 million	6.7 million
Orange	3 million	2.2 million
San Diego	3 million	2.3 million
San Bernardino	1.8 million	1.3 million
Riverside	1.7 million	1.2 million
Ventura	0.8 million	0.7 million
Imperial	0.15 million	0.1 million
Total	**20.5 million**	**14.5 million**

*Includes autos, trucks, and motorcycles. Trailers not included.

With respect to transportation funding and planning, Southern California consists of four distinct regions that roughly correspond with the four Southern California Caltrans districts:

‣ Los Angeles County/Ventura County (Caltrans District 7)
‣ Orange County (Caltrans District 12)
‣ Inland Empire (Caltrans District 8)
‣ San Diego (Caltrans District 11)

These four regions are shown in Exhibit 2 with an arc roughly defining the Priority Corridor.

Exhibit 2 – Caltrans Districts in Southern California

Each of these regions has its own collection of agencies responsible for various aspects of transportation funding, planning, operations and maintenance. These agencies and their responsibilities include:

Exhibit 3 – Transportation Agencies in Southern California by Region

Agency	Responsibility
Los Angeles/Ventura	
Caltrans, District 7	Operates and maintains those portions of interstate freeways and state highways that lie within Los Angeles County and Ventura County.
Ventura County Transportation Commission (VCTC)	Develops and implements transportation policies, projects, funding and priorities for projects that involve highways, bus services, bicycling and bike paths, aviation, commuter and freight railroads and other transportation issues in Ventura County. Controls and reviews the use of federal, state and local funds for transportation and related projects, and also serves as the Airport Land Use Commission Service Authority and Freeway Emergencies Congestion Management Agency
Los Angeles County Metropolitan Transportation Authority (MTA)	Acts as the transportation commission for Los Angeles County, as well as operates and maintains bus and light rail transit service for the region.
Southern California Association of Governments (SCAG)	The Metropolitan Planning Organization (MPO) for Los Angeles, Ventura, Orange, San Bernardino, Riverside, and Imperial Counties (i.e., all of Southern California except San Diego County). As the designated MPO, SCAG is mandated by the federal government to research and draw up plans for transportation, growth management, hazardous waste management, and air quality. Additional mandates exist at the state level.
Los Angeles Department of Transportation (LADOT)	Operates and maintains the local traffic network within the City of Los Angeles.

Agency	Responsibility
Los Angeles County Department of Public Works (LACDPW)	LACDPW is responsible for the design, construction, operation, maintenance, and repair of roads, bridges, airports, sewers, water supply, flood control and water conservation facilities; and for the design and construction of capital projects.
South Coast Air Quality Management District (SCAQMD)	SCAQMD, by law, is required to achieve and maintain healthful air quality for the residents of Los Angeles County, Orange County, and the adjacent parts of San Bernardino and Riverside counties. This is accomplished through a comprehensive program of planning, regulation, compliance assistance, enforcement, monitoring, technology advancement, and public education.
Orange County	
Caltrans, District 12	Operates and maintains those portions of interstate freeways and state highways that lie within Orange County.
Orange County Transportation Authority (OCTA)	Acts as the transportation commission for Orange County, as well as operates and maintains bus and light rail transit service for the region.
Southern California Association of Governments (SCAG)	See description under Los Angeles/Ventura.
Inland Empire	
Caltrans, District 8	Operates and maintains those portions of interstate freeways and state highways that lie within San Bernardino County and Riverside County.
San Bernardino Association of Governments (SANBAG)	As the County Transportation Commission, SANBAG supports freeway construction projects, regional and local road improvements, train and bus transportation, railroad crossings, call boxes, ridesharing, congestion management efforts and long-term planning studies.
Riverside County Transportation Commission (RCTC)	RCTC is Riverside County's primary transportation agency charged by state law with the responsibility of planning and funding improvements.
Southern California Association of Governments (SCAG)	See description under Los Angeles/Ventura.
San Diego	
Caltrans, District 11	Operates and maintains those portions of interstate freeways and state highways that lie within San Diego County and Imperial County.
San Diego Association of Governments (SANDAG)	The Metropolitan Planning Organization (MPO) for San Diego County. Builds consensus, makes strategic plans, obtains and allocates resources, and provides information on a broad range of topics pertinent to the region's quality of life. As of January 1, 2003, a new state law consolidated all of the roles and responsibilities of SANDAG with many of the transit functions of MTDB and NCTD. The consolidation allows SANDAG to assume transit planning, funding allocation, project management and eventually construction in the San Diego region in addition to its other ongoing roles and responsibilities.
Metropolitan Transit Development Board (MTDB)	Operates and maintains bus and light rail transit service in and around downtown San Diego.
North County Transit District (NCTD)	Operates and maintains transit bus and commuter rail service for northern San Diego County.

To help coordinate ITS activities on a regional level, each region hosts its own ITS Strategic Planning Team comprised primarily of the respective member agencies listed above as well as representatives from local municipal traffic departments and law enforcement/emergency response. These ITS strategic planning teams were developed in the early 1990's prior to the formation of the Southern California ITS Priority Corridor and the Showcase Program.

2.2   The Federal ITS Priority Corridors Program

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 declared, "An IVHS Corridors program is established to provide for operational tests under 'real world' conditions. Corridors which meet certain transportation and environmental criteria can participate in developing and implementing IVHS technologies." A few years later, in March 1993, the U.S. Department of Transportation selected Southern California as one of four Priority Corridors in which Intelligent Transportation Systems (ITS) could have particular benefit.

As a result, the Federal Highway Administration (FHWA) signed a Partnership Agreement in July 1994 with Caltrans' Division of Research & Innovation (formerly New Technology & Research), and authorized a total of $7.355 million in federal money over fiscal years 1993-1995[4] to fund several initial activities, including:

‣ Corridor-wide Plan
‣ Four regional Early Deployment Plans (Los Angeles/Ventura, Orange County, San Diego, and Inland Empire)
‣ Early Deployment Plan for the U.S.-Mexico Border
‣ Initiation of the Showcase Program through the Scoping & Design (Phase 1) project[5]

2.3   The Introduction of Showcase

The Southern California Priority Corridor Steering Committee was officially established on April 4, 1995 to bring together stakeholders from the four regional ITS strategic planning teams, Caltrans, the California Highway Patrol (CHP), and the Federal Highway Administration (FHWA). The Steering Committee represents the coalition of agencies working in cooperation to guide the Showcase Program, but it is not a legal entity such as a Joint Powers Authority (JPA).

Some of the first activities of the Steering Committee were to oversee the development of the Early Deployment Plans and to authorize the Scoping & Design (Phase 1) project. As the name implies, the Scoping & Design project conducted an early Needs Assessment and developed high-level Functional Requirements to refine the scope of the Showcase Program and begin preparing a high-level system architecture and design. Through this activity, 20 individual ITS projects were identified to collectively plan, design, and deploy Showcase's Corridor-wide intermodal transportation management and information network. Of these 20 proposed projects, FHWA approved 17 for funding. Eleven of these 17 projects are specific to particular regions, while the remaining six provide Corridor-wide services and inter-regional infrastructure.

The 17 Showcase projects are listed by geography in Exhibit 4, which also indicates the original scope of each project as determined between 1995-1997 by the Scoping & Design (Phase 1) effort. Eight of the projects were fast-tracked and designated "Early Start" projects because of their importance as base infrastructure and potential to act as role models for the rest of the Showcase Program. These "Early Start" projects are identified in Exhibit 4 with a (*).

Exhibit 4 – Work Scopes of the 17 Individual Showcase Projects in 1997

Project	Scope
Corridor-wide Projects	
Corridor-wide Advanced Transportation Management System (CWATMS)	Integrates ATMS's throughout the Priority Corridor for sharing data and video for coordinated transportation management.
Corridor-wide Advanced Traveler Information System (CWATIS)	Establishes standard technical and operational practices for ATIS's throughout the Priority Corridor.
Corridor-wide Commercial Vehicle Operations (CWCVO)	Provides a traveler information system tailored to the needs of the commercial vehicle operations community.
Corridor-wide Rideshare	Provides San Diego transit data to SCAG's TranStar transit-based Itinerary Planning tool. The change will broaden the system's coverage to nearly all of Southern California.
Corridor-wide System Integration Project (CWSIP) (Later renamed the Corridor-wide Strategic Planning Project, CWSPP)	Ensures that the systems of the Priority Corridor are interoperable and sustainable. This project integrates Showcase projects into a "system-of-systems" and provides configuration management.
Scoping & Design (Kernel)*	Performs program scoping and high-level design activities. Designs and implements the inter-regional Showcase Network and the interface point(s) for the other Showcase projects. These interfaces are referred to as the Kernel(s).
Los Angeles/Ventura Projects	
IMAJINE*	IMAJINE is an acronym for "Inter-Modal and Jurisdictional Integrated Network Environment." IMAJINE develops and integrates arterial, freeway and transit management systems at the Gateway Cities subregional TMC, Caltrans District 7, MTA and ASI (paratransit).
Los Angeles/Ventura Regional ATIS	Collects data from a mix of existing public sources and provides information services to travelers and private value-added resellers (VARs).
Mode Shift*	"Mode Shift" is short for "Intermodal Shift Management System." Will provide transit related traveler information and be developed in close cooperation with the IMAJINE project and the Los Angeles/Ventura Regional ATIS project and may provide the Caltrans District 7 connectivity to the regional Kernel.
Orange County Projects	
TravelTIP*	Collects data from a mix of existing data sources and provides traveler information tailored to Orange County. Acts as the "information engine" for the OCMDI.
OCMDI	OCMDI is an acronym for "Orange County Model Deployment Initiative." The OCMDI helps foster a fully privatized traveler information market by collecting and providing raw transportation data to Information Service Providers (ISPs) in a profit-sharing enterprise.
Inland Empire Projects	
Fontana-Ontario ATMIS	This project implements a TMC for the City of Fontana and a regional ATIS to help manage traffic from sources such as the Ontario Convention Center, Ontario Mills Mall, Ontario International Airport and the California Speedway in Fontana. Additionally, the project integrates the new TMC and TIC with the Showcase Network via the Inland Empire Kernel located at Caltrans District 8.

Project	Scope
San Diego Projects	
InterCAD*	Integrates law enforcement and emergency response agencies' computer aided dispatch (CAD) systems with freeway management systems.
IMTMS/C*	IMTMS/C is an acronym for "Intermodal Transportation Management System/Center." This project optimizes and coordinates freeway and surface street operations with public and private transportation systems by integration of intermodal transportation information, and intermodal transportation management systems.
Mission Valley ATMIS* (Sometimes referred to as Mission Valley Event Management, MVEM)	Integrates and interconnects ITS components surrounding Qualcomm Stadium with arterial and freeway management systems at the City of San Diego and Caltrans District 11, respectively.
San Diego Traffic Signal Integration	Integrates traffic signal systems throughout San Diego County to improve traffic flow between jurisdictions.
San Diego Transit Management System*	Develops and integrates transit management centers at each transit provider in San Diego County. Exchanges real time transit information with the intermodal TMS/C at Caltrans District 11.

As project scopes were developed and work orders approved, federal funding was channeled from FHWA to Caltrans headquarters through successive amendments to the initial Partnership Agreement. The amendments are described in Exhibit 5.

Exhibit 5 – Listing of Amendments to the Priority Corridor Partnership Agreement

	Date	Value	Scope
Amendment 1	7/7/1995	$3,428,000	Funding for TravelTIP, Phase 2
Amendment 2	9/1/1995	$5,000,000	Funding for four San Diego "Early Start" projects, including: ▪ InterCAD, Phase 2 ▪ Transit Mgt System ▪ Mission Valley ATMIS ▪ IMTMS, Phase 1
Amendment 3	7/8/1996	$7,850,000	Funding for: ▪ Scoping & Design, Phases 2 - 3 ▪ Mode Shift ▪ IMAJINE ▪ LA/Ventura ATIS ($1.3M) ▪ Fontana-Ontario ATMIS ($2.3M)
Amendment 4	9/3/1997	$8,560,000	Funding for: ▪ CWATMS ($2.3M) ▪ CWATIS ($0.5M) ▪ CWSIP ($0.5M) ▪ CW Rideshare ($0.1M) ▪ OCMDI ($2.1M) ▪ San Diego Traffic Signal Integration ($1.1M) ▪ CWCVO ($0.6M) ▪ Evaluation ($1.36M)
Amendment 5	6/4/1997	($112,000)	Deobligates $112,000 for interim Evaluation
Amendment 6	11/17/1997	($130,974)	Deobligates $130,974 for interim Evaluation
Amendment 7	6/13/1998	($130,000)	Deobligates $130,000 for interim Evaluation

Based on the initial Partnership Agreement and subsequent amendments, the total federal funding for Showcase was $32,193,000. Caltrans headquarters distributed the funding to the Caltrans district offices, which ultimately distributed it to the local agencies who often provided matching funds and hired the consultant contractors (as shown in Exhibit 6). In most cases, the professional services of consultants were procured by the local agencies.

Exhibit 6 – Paths of Agreements and Funding for Showcase Program Projects
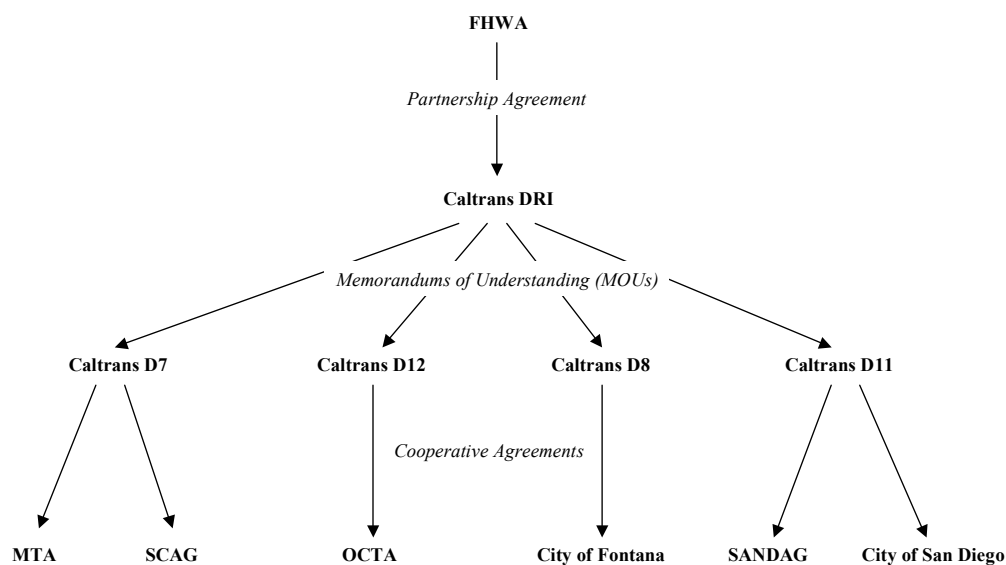
Exhibit 7 lists the Showcase projects and their sponsor agencies. Exhibit 7 also provides details on the funding and timing of each project and project phase where available. In some cases, information has yet to be determined (TBD) or is not available (na).
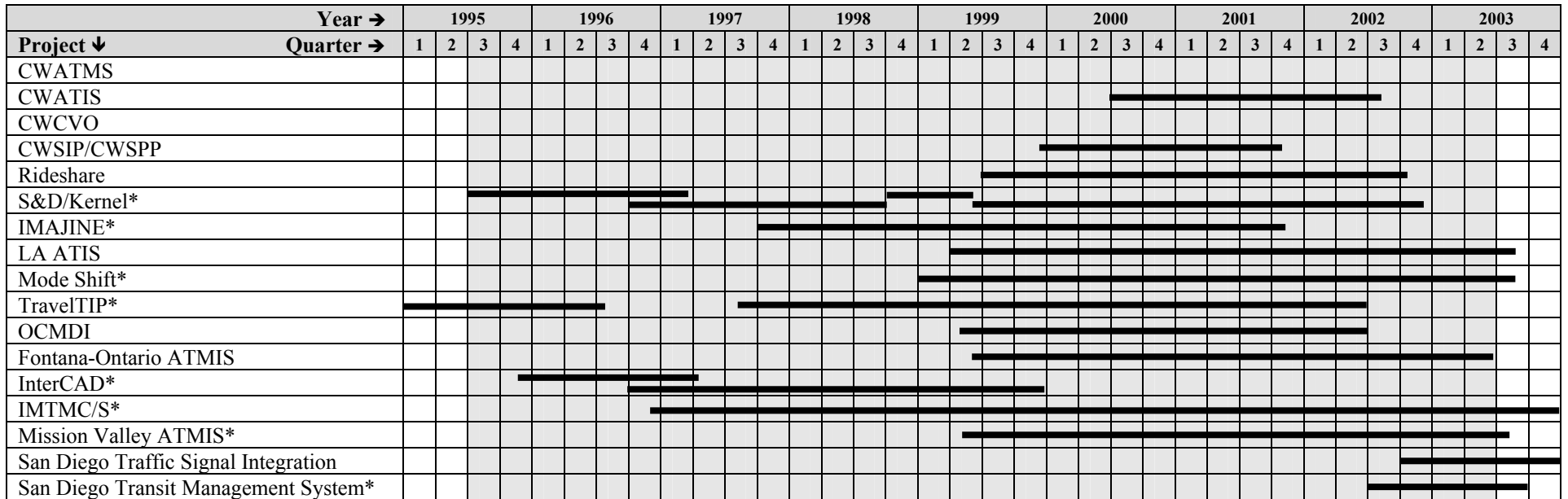
Exhibit 7 – Showcase Project Start and End Dates

Project Name	Contracting Agency	Funded by Showcase	Start Date	End Date	Duration (months)
Corridor-wide					
CWATIS	Caltrans DRI	✓	6/2000	8/2002	26
CWATMS	NA	✓	TBD	TBD	TBD
CWCVO	SANDAG	✓	TBD	TBD	TBD
CWSIP/CWSPP	Caltrans DRI	✓	12/1999	10/2001	22
Rideshare	SCAG				
Phase 1		✓	6/1999	10/2002	40
Phase 2			TBD	TBD	TBD
Phase 3			TBD	TBD	TBD
Scoping & Design	SANDAG				
Phase 1		✓	6/1995	3/1997	21
Phase 2		✓	9/1996	10/1998	25
Phase 2a		✓	10/1998	5/1999	7
Phase 3		✓	5/1999	11/2002	42
Los Angeles/Ventura					
IMAJINE	MTA	✓	9/1997	11/2001	50
LA-Ventura ATIS	MTA	✓	4/1999	7/2003	50+
Mode Shift	Caltrans D7	✓	1/1999	2/2004	61
Orange County					
TravelTIP	OCTA				
Phase 1			1/1995	7/1996	18
Phase 2		✓	7/1997	6/2002	60
OCMDI	OCTA	✓	4/1999	6/2002	38
Inland Empire					
Fontana-Ontario ATMIS	City of Fontana	✓	5/1999	6/2003	48
San Diego					
InterCAD	SANDAG				
Phase 1			11/1995	4/1997	18
Phase 2		✓	10/1996	12/1999	38
IMTMS/C	Caltrans D11				
Phase 1		✓	1/1998	underway	80+
Phase 2		✓	1/2001	underway	46+
Mission Valley ATMIS	City of San Diego	✓	4/1999	7/2003	50+
Traffic Signal Integration	SANDAG				
Tier 1		✓	10/2002	underway	25+
Tier 2			na	underway	na
Transit Mgt System	SANDAG	✓	6/2002	underway	12+

The first phases of TravelTIP and InterCAD were not funded through the Showcase Program, but were local efforts already well underway prior to the completion of Scoping & Design (Phase 1). In the case of the Traffic Signal Integration (i.e., RAMS) project, Tier 1 was funded through Showcase, but Tier 2 will be funded locally. Exhibit 8 provides a Gantt chart of the Showcase projects, and reveals the large number of concurrent efforts that were underway in the late 1990's and early 2000's.

Exhibit 8 – Gantt Chart of the Showcase Program

The bars represent the duration of individual phases of each project. The shaded area represents the timeframe of the Showcase Program, beginning with the kick off of the Scoping & Design Phase 1 effort. Showcase funds expired on June 30, 2003.

Project ↓ / Year →	1995				1996				1997				1998				1999				2000				2001				2002				2003			
Quarter →	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CWATMS																																				
CWATIS																					━	━	━	━	━	━	━	━	━							
CWCVO																																				
CWSIP/CWSPP																			━	━	━	━	━													
Rideshare																		━	━	━	━	━	━	━	━	━	━	━	━	━						
S&D/Kernel*			━	━	━	━	━	━	━	━	━	━	━	━			━	━	━	━	━	━	━	━	━	━	━	━								
IMAJINE*											━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━										
LA ATIS																			━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	
Mode Shift*																			━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━		
TravelTIP*	━	━	━	━	━	━				━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━							
OCMDI																			━	━	━	━	━	━	━	━	━									
Fontana-Ontario ATMIS																			━	━	━	━	━	━	━	━	━	━	━	━	━					
InterCAD*					━	━	━	━	━	━	━	━	━	━	━	━	━	━																		
IMTMC/S*								━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━	━						
Mission Valley ATMIS*																			━	━	━	━	━	━	━	━	━	━	━	━	━					
San Diego Traffic Signal Integration																														━	━	━	━	━	━	━
San Diego Transit Management System*																														━	━	━	━	━	━	

3 Program-wide Results and Lessons Learned

This section covers a wide range of topics and lessons learned regarding program structure, project partnering, contracting strategies, and other specific project deployment issues. Many of these topics are interrelated such that one area may have a rippling impact into one or more of the others. Understanding these relationships, and the key importance of some decisions made early in a program's life, will help others successfully plan and execute similarly complex programs in the future.

3.1 Program Organization and Management

3.1.1 Organizational Structure: Decision-Making and Program Guidance

The Showcase Program is directed by a Steering Committee comprised of representatives from the Priority Corridor's four regional ITS strategic planning teams, as well as stakeholders from the state and federal levels. As a result, the Steering Committee reflects wide representation from the Priority Corridor in terms of federal and state highway agencies, public safety, cities and counties, transit, air quality and regional planning entities. The full membership includes:

- California Highway Patrol (CHP)
- Caltrans, Division of Research & Innovation (DRI) (formerly the Division of New Technology & Research, NTR)
- Caltrans, District 7
- Caltrans, District 8
- Caltrans, District 11
- Caltrans, District 12
- City of Irvine
- City of Los Angeles Department of Transportation (LADOT)
- City of San Diego
- Federal Highway Administration (FHWA)
- Federal Transit Administration (FTA)
- Los Angeles County Metropolitan Transportation Authority (MTA)
- Orange County Transportation Authority (OCTA)
- Riverside County Transportation Commission (RCTC)
- San Bernardino Association of Governments (SANBAG)
- San Diego Association of Governments (SANDAG)
- South Coast Air Quality Management District (SCAQMD)
- Southern California Association of Governments (SCAG)

Although the Steering Committee provides a unique forum for communicating ideas and coordinating ITS activities on a Corridor-wide basis, it is not a legal entity. The Steering Committee depends upon the voluntary cooperation of these member agencies. The agencies signed an MOU to join the Steering Committee, and then appointed committee representatives.

Exhibit 9 – Management Structure of the Showcase Program
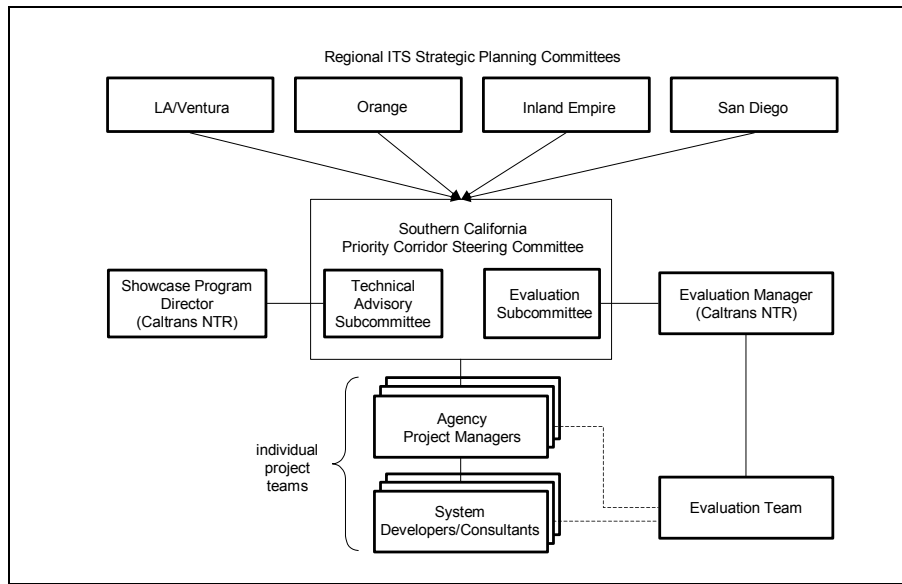
The Steering Committee has two standing subcommittees: the Technical Advisory Subcommittee (TAS) and the Evaluation Subcommittee.

The TAS – initially named the Technical Management Subcommittee (TMS) – consists of technical experts from both the private consultants and the public agencies, and is tasked with providing guidance to the Steering Committee on engineering and technology issues. Initially, these issues related to the Corridor-wide architecture, but, as time progressed, the technical issues became more focused on the regional systems that were being developed by the individual Showcase projects.

To reassert that the TMS was meant to be an advisory body, and that it did not have "management" authority over regional projects, the Steering Committee renamed the group in February 1999 the Technical Advisory Subcommittee (TAS). The Steering Committee invited the regional projects to utilize the technical resources of the TAS as needed, though use of the TAS was not required.

The Steering Committee's other standing subcommittee – the Evaluation Subcommittee – reviews evaluation issues and products. The Evaluation Subcommittee consists of Caltrans' Evaluation Contract Manager and representatives from FHWA, Caltrans headquarters, and each of the four regions of the Priority Corridor. All draft evaluation documents were submitted to the Evaluation Subcommittee for review and comment before being finalized.

In August 1999, the Steering Committee chose to create a "Chief of Staff" position to oversee the 17 Showcase projects and present status reports back to the committee. Several candidates applied for the position, and, in January 2000, Ali Zaghari of Caltrans DRI was selected to be Showcase's first Program Director. Mr. Zaghari, assisted by his four staff, held this position for 11 months until he was reassigned to Caltrans District 7 in November 2000. He continued to fill the Program Director role part time during a transition period that ended in June 2001. At that

time, George Hattrup of Caltrans DRI assumed the Program Director position. Mr. Hattrup held the position until he resigned from Caltrans in May 2002.

Recognizing that funding for the Showcase Program would expire on 30 June 2003, a Transition Team was formed (in lieu of selecting another Program Director) to help facilitate the mainstreaming of Showcase management from the Steering Committee to an appropriate agency or collection of agencies. Since most of the transportation funding in Southern California is programmed at the regional level, the regional transportation commissions (i.e., MTA, OCTA and SANDAG) have taken responsibility for the systems in their respective regions. Caltrans has temporarily taken responsibility for the inter-regional components.

3.1.2 Organizational Structure: Technical Management

During the first few years of the Showcase Program, technical management fell to the individual contracting agencies and their consultants. The Scoping & Design contract provided the high-level design for all of Showcase, and the project's two consultants ultimately became contractors (either as the prime contractor or a subcontractor) on eight (8) of the remaining 14 Showcase projects that have been awarded to-date (CWATMS and CWCVO have not been awarded). Although this aided the transfer of knowledge and understanding regarding Showcase's high-level design to those eight projects, it also created the perception of a disadvantage for the other six projects. As the Scoping & Design project began developing the more detailed system interface specifications (called Interface Definition Language or IDL) for Showcase, a perception arose that not all of the regional projects had equal access to all of the necessary interface information. Unresolved, this issue eventually resulted in many of the regional Showcase systems not integrating to the inter-regional network as a unified, Corridor-wide "system of systems."

The knowledge transfer issues during Showcase might have been abated by the utilization of an independent, high-level systems engineering team to develop the system architecture and provide coordination and technical oversight throughout the program's lifecycle. There is a precedent for this in large, complex U.S. Department of Defense programs that involve several contractors working on individual pieces of a larger system. The U.S. Department of Defense refers to this systems engineering and project management team as a SETA (Systems Engineering & Technical Analysis) consultant.

More specifically, a SETA consultant is an independent, multi-disciplinary advisory team – which might be comprised of either agency staff or a hired contractor – to aid with preliminary planning and ongoing program management.

The SETA consultant might perform one or more of the following functions:

‣ Help define, schedule and sequence specific projects or tasks to address program goals
‣ Conduct feasibility studies
‣ Develop cost estimates for system development and O&M
‣ Conduct program-level Needs Assessment and Requirements definition
‣ Prepare the high-level, program-wide system architecture
‣ Identify or prepare specifications and standards
‣ Act as the central information clearinghouse for the program
‣ Provide ongoing technical oversight for the program, including configuration management

In short, the SETA consultant keeps an eye on the "big picture" and helps ensure that the smaller individual pieces eventually come together as desired. To remain independent and objective, the SETA consultant is precluded from bidding on or conducting any of the system implementation. The contracting agency hires one or more contractors to perform the implementation, and the SETA consultant continues to aid the agency by providing technical oversight.

Exhibit 10 – Organizational Relationships when Using a SETA Consultant
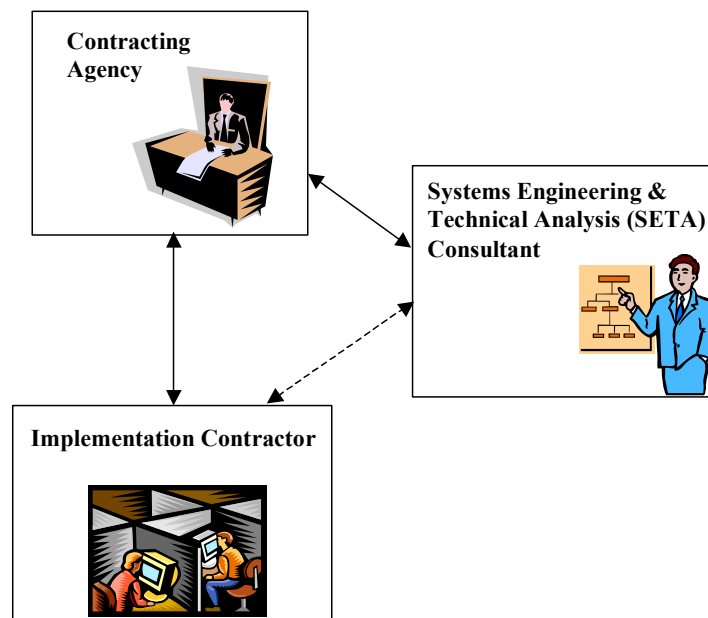
In California, any state-led agency or department that wishes to use state funds to procure or acquire a new system must document a sound business case in a Feasibility Study Report (FSR), which must then be reviewed and approved by the Department of Finance (DOF). Up until 1999, Caltrans was exempted from this process. The SETA consultant could also perform much of the cost estimating and feasibility analysis that goes into preparing an FSR.

3.1.3   Contracting

Here are a number of observations regarding Showcase's consultant contracts:

‣ Work scopes in Showcase project RFPs tended to focus more on "process" than on intended "end product" by emphasizing a systems engineering process, though the dictated processes varied slightly between RFPs.

‣ All had overly aggressive or overly optimistic schedules.

‣ The majority of the Showcase projects utilized single fixed-price contracts to plan, design, and implement their respective systems.

The Showcase Program provides empirical evidence supporting the importance of following the Federal Highway Administration's (FHWA's) "Rule" and Federal Transit Administration's (FTA's) "Policy" on implementing ITS.

In early 2001 – roughly six years after the start of the Showcase Program – the FHWA and FTA issued their respective "Rule" and "Policy" on "Intelligent Transportation Systems and Standards." The Rule/Policy contains two particularly important high-level requirements (and several supporting detailed requirements) regarding ITS planning and project implementation:

1. "A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans."

2. "All ITS projects funded with Highway Trust Funds shall be based on a systems engineering analysis that is on a scale commensurate with the project scope."

Although most of Showcase's deployment projects began before the Rule/Policy was published, all of them followed some form of logical systems engineering approach. The tasks and deliverables specified in the project work scopes generally included:

‣ Needs Analysis/Requirements Definition
‣ High-Level Design
‣ Detailed Design
‣ Implementation/Installation/System Integration
‣ Acceptance Testing

However, a clinical application of "process" does not guarantee project success. In fact, the work scopes in the various Showcase project RFPs may have over-emphasized "process" to the detriment of expressing a clear vision of the intended "end product."

One of the detailed supporting requirements in the Rule/Policy refers to developing an "operational concept" (or Concept of Operations, ConOps) to define the roles and responsibilities of the participating agencies and to plan ahead for operations and maintenance. A ConOps is a useful first step in a project because it can help the project stakeholders establish a common vision of the end product and a common understanding of how the system will be used. In addition, a ConOps can help uncover critical institutional issues early, such as:

1. Does the system require any shared use of field devices between agencies?

2. Does the system require access to any secure networks, as might belong to law enforcement/public safety?

3. Will the system require a human operator, or can it be automated? What human resources are available?

4. Are any interagency agreements or MOUs necessary to cover liability concerns or O&M costs?

As with following the systems engineering process, preparing a ConOps will not necessarily guarantee project success, but it will help reduce the risk of project failure.

Developing regional ITS architectures in compliance with the Rule/Policy should also help streamline project schedules. Most of the Showcase projects required more than 48 months to complete even though their original schedules were for 18-24 months. As opposed to calling the projects "late," it seems more realistic that the level of effort was underestimated and that the original schedules were simply too aggressive or overly optimistic. The Needs Assessment and System Requirements tasks are neither trivial nor predictable when a project involves multi-jurisdictional integration of systems and operations as found in many ITS projects. The Showcase projects – and other ITS projects around the nation – have shown that the requirements definition phase can be as unpredictable as the system implementation phase. The consensus building activities required to develop a satisfactory Concept of Operations (ConOps), set of Requirements, and High-Level Design can require this phase alone to take 18-36 months to complete. This phase might then be followed by another 18-36 months of Detailed Design, Implementation, and Testing. Much depends on the institutional framework, relationships, and agreements that already exist between the project partners. Experience has shown that – in many cases – it is futile to proceed with an ITS implementation until the institutional agreements (multi-jurisdictional operations policies, cooperative agreements, MOUs, etc.) are in place to promote and support operation of the system. This further highlights the importance of developing a detailed ConOps early, and as part of both the regional ITS architecture as well as the specific ITS project.

Lastly, many of the Showcase projects utilized single fixed price contracts both to design and implement their systems. Whether a project should be contracted as "fixed price" or "time & materials" depends upon how well the project requirements are understood upfront, and the amount of financial risk that each party is willing to accept. Certainly, the underlying goal should be to arrive at a balanced agreement that is fair to both parties: the contracting agency and the private consultant.

However, agencies might consider that by splitting a project into separate Design and Implementation contracts or task orders, they could gain flexibility and reduce risk. Splitting the project would allow an agency to develop a ConOps and estimate the implementation schedule and cost before committing the additional resources to proceed. This was done for Showcase's CWATIS and CWATMS projects, and ultimately may have saved the Showcase Program over $1 million.

In this specific case, the CWATIS project had been re-scoped to develop the ConOps, Requirements, and High-Level Design for an Integrated Workstation (IWS), which would consolidate many of the features of the various regional systems into a single workstation that could be distributed as the Corridor-wide standard. Whereas CWATIS would prepare the high-level design, the CWATMS project would refine the design and ultimately build the IWS. This planned sequencing of the CWATIS and CWATMS projects is depicted in Exhibit 11.

Exhibit 11 – Planned Sequencing of the CWATIS and CWATMS Projects
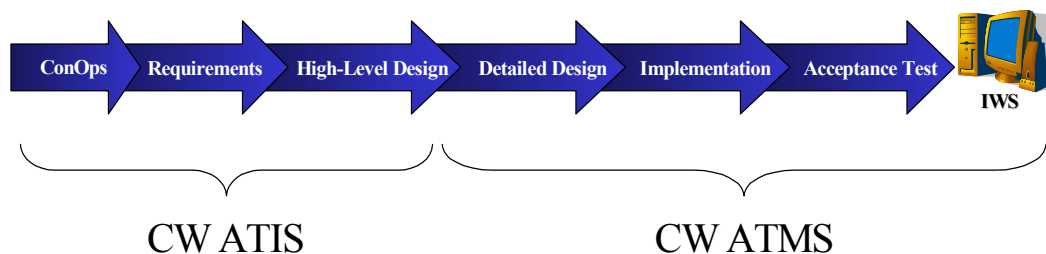
Through the CWATIS project, however, it was determined that San Diego's IMTMC/S project was already developing a system (called ATMSi) that had most of the desired features of the planned IWS. This made further development of the IWS unnecessary. By choosing to utilize the ATMSi system in place of the IWS, the Steering Committee was able to redirect the CWATMS funds to other pressing needs within the Priority Corridor.

Although combining the Design and Implementation phases into a single contract eliminates the administrative burden of executing multiple contracts or task orders, the cost and risk associated with committing to build a system before the needs or institutional issues are fully understood might outweigh that benefit.

3.1.4   Partnering with local agencies

Most agencies recognize the potential benefits of increased information sharing and improved coordination; however, not all agencies are necessarily prepared to handle the financial, technological, and other resource requirements of ITS. Some of the challenges that were encountered by local agencies during Showcase projects include:

‣ Lack of familiarity with technology

Some of Showcase's local agency partners did not yet have email service when they joined the Showcase Program in the late 1990's. Understandably, these agencies had little experience with

information technologies and were somewhat overwhelmed by ITS. In some cases, this lack of familiarity with technology resulted in fear and a reluctance to use the systems being developed. This challenge can be dealt with, however, through ongoing follow-ups by the lead agency to gather feedback on system performance and encourage the partners to use the system. These follow-ups are necessary until the system becomes mainstreamed or "institutionalized."

▶ Shortage of staff available to operate and maintain the system

Unless the agency already has staff dedicated to operating and maintaining some existing ITS, it may have to reassign staff from other duties. Some other approaches that were successfully employed by Showcase partners to deal with the staffing challenge include: (1) requiring that the new system be able to operate automatically with little or no operator intervention, or (2) making use of part-time student interns to monitor the system and perform data entry

▶ Shortage of available budget to operate and maintain the system

Many agencies are eager to experiment with ITS, but do not have the financial resources to fund ongoing operations and maintenance. In the Los Angeles region, the MTA requires – as a condition of its participation – that each partner agency be able to fund the O&M of its own respective system. The MTA will not pay for the operations and maintenance of another agency's ITS. This helps ensure that MTA's ITS project partners are committed to using the systems once built. But the O&M costs of ITS can be prohibitive. In order to encourage greater deployment and use of ITS, OCTA and SANDAG often cover ITS O&M costs on behalf of their local partner jurisdictions.

▶ Inconsistent operation of the systems

Most of the Showcase systems have not reached a level of consistent, steady-state operation, which may have negatively influenced user acceptance.

3.2   Technology and Deployment

3.2.1   Documentation

The Showcase Architecture provides the greatest flexibility to the Program's agency partners by allowing their systems to be designed as "black boxes" on the network. Under this design approach, no one needs to know the details of the inner workings of the various regional systems as long as those systems utilize the Showcase Program's standard Interface Definition Language (IDL) to communicate.

As a result, large integration programs such as Showcase should not underestimate the value of budgeting for technical writers (perhaps as part of a SETA contract) to prepare and maintain accurate and thorough documentation of system designs and interfaces throughout the project

lifecycle. Many projects finalize their design documents at the end of the Design task, but before the implementation is complete. However, design changes often continue to take place as the developer encounters and overcomes the inevitable and unforeseen technical challenges that arise. To ensure that all of these changes are recorded, projects should budget for ongoing revision of design documentation until the end of the project, resulting in "as built" documentation.

In the case of Showcase, several projects did not integrate with the Showcase Network because they perceived that the available design and interface documentation was either not complete or not accurate. When specifically describing an object-oriented software system, such documentation should include, at a minimum, class diagrams, sequence diagrams, and textual descriptions that explain how object attributes and methods are to be used. Here is a list of industry standards that agencies might consider using when preparing ConOps, requirements specifications, design documentation, and test plans:

ConOps	Requirements & Design Docs	Test Plans
‣ IEEE P1362 ‣ ANSI/AIAA G-043-1992 ‣ US DoD DI-MCCR-80023	‣ ISO/IEC 12207 ‣ IEEE 1233 ‣ IEEE 1471 ‣ U.S. Department of Defense DI-IPSC-81433 ‣ BSI BS-5515 ‣ BSI BS-7738 ‣ NASA DID-P400 & P410	‣ IEEE 829 ‣ IEEE 1008 ‣ IEEE 1012

Since design, implementation, and testing is often an iterative process, it is ideal to update the system's technical documentation continually through the end of the project.

Concerns over the accuracy and completeness of the technical documentation, a desire to share and reuse software source code between projects, and an attempt to institute Corridor-wide configuration management eventually raised several issues with Intellectual Property Rights (IPR).

3.2.2   Software Development and "Design Once, Deploy Many Times"

One of the credos of the Showcase Program was "Design Once, Deploy Many Times," which seeks system standardization, program efficiency and cost savings through software reuse. Although there are clear examples of software reuse within individual projects (such as TravelTIP) and between projects awarded to the same contractor, agency policies and legal barriers prevented a wider exchange and subsequent reuse of software source code between agencies, contractors and projects. Specific contract language regarding Intellectual Property Rights (IPR) and Non-Disclosure Agreements (NDA) restricted the free sharing of software source code between agencies when the intent seemed to be that the code would be subsequently shared with another contractor.

In general, legal precedents restrict public agencies from sharing custom-developed software source code with private third-parties, even if the software development was entirely funded by the public sector. This is because the source code may contain proprietary innovations or "trade secrets" of the developer, which may not be disclosed to the marketplace. However, agencies that have their own Information Technology staff may often negotiate the right to view and modify the code "in house" or to share the source code with other public agencies within the same region or state. Such sharing can be a benefit to regional standardization and integration.

A review of several Showcase project contracts revealed that the agencies of the Priority Corridor vary in their software ownership policies. Some agency stakeholders have suggested that the Priority Corridor might benefit from the development and adoption of a more consistent software source code ownership policy.

Regardless, agencies must identify and negotiate IPR/software source code ownership rights with their vendors and sub-vendors up front to help avoid the possibility of litigation later on.

4   Corridor-wide Projects

This chapter summarizes the evaluation findings from the Corridor-wide projects. This chapter addresses those projects' system performance, costs, institutional impacts, utilization, and transportation system impacts.

4.1   Overview and Technical Descriptions

The Showcase Program includes six Corridor-wide projects:

‣ Corridor-wide Advanced Traveler Information System (CWATIS)
‣ Corridor-wide Advanced Transportation Management System (CWATMS)
‣ Corridor-wide Commercial Vehicle Operations (CWCVO)
‣ Corridor-wide System Integration Project/Strategic Planning Project (CWSIP/CWSPP)
‣ Corridor-wide Rideshare (CW Rideshare)
‣ Scoping & Design (Kernel)

Four of these projects have been concluded to-date. These include Scoping & Design (the Kernel), CWSPP (formerly CWSIP), CWATIS, and CW Rideshare. CWATMS and CWCVO have not kicked off.

Corridor-wide Advanced Traveler Information System Project (CWATIS)

The CWATIS project helped design – but not build – an Integrated Workstation (IWS) that would bring together into one system all of the functionality from the various regional systems such as TravelTIP, IMAJINE, and Mission Valley ATMIS. The IWS would represent the next evolutionary step in the development of Showcase's inter-regional, Corridor-wide capability.

Specifically, the CWATIS project completed the first steps of a systems engineering process by developing the Concept of Operations (ConOps), Requirements, and High-Level Design for an IWS.

Corridor-wide Advanced Transportation Management System (CWATMS)

The original goal of the CWATMS project was to integrate the Advanced Transportation Management Systems at Caltrans' four Transportation Management Centers (TMCs) in the Priority Corridor. However, over the past six years, the four regions of the Southern California Priority Corridor have come to place local or regional integration as a higher priority than inter-regional or Corridor-wide integration. As a result, Los Angeles County and San Diego County are each developing their own regional networks based on the Showcase Architecture to enable greater coordination between their respective local transportation agencies. Orange County and the Inland Empire are expected to do the same. One day, these four separate regional networks may be interconnected to form the Corridor-wide network envisioned by the Showcase Program.

Corridor-wide Commercial Vehicle Operations (CWCVO)

Although this project has not yet kicked off, the project funds still reside with SANDAG. The agency currently plans to use these funds for the CVO component of its upcoming 5-1-1 project.

Corridor-wide Strategic Planning Project (CWSPP)

This project was initially named the Corridor-wide System Integration Project (CWSIP), but was renamed to be more indicative of its scope. According to the final revised project workplan dated August 2000, the goal of the CWSPP was to "ensure that the systems of the Priority Corridor are interoperable and sustainable." The project worked toward this goal through the development of two deliverables: a Configuration Management Plan (CMP) and a Systems Integration Plan (SIP). The purpose of the CMP was to help establish a process for controlling the development and change of the Priority Corridor systems over time and to help ensure their near-term and long-term ability to communicate and share information with one another. The SIP provides for the deployment of necessary interfaces to create an integrated, interoperable and sustainable Corridor-wide ITS Showcase network.

Corridor-wide Rideshare (CW Rideshare)

The Southern California Association of Governments (SCAG) operates and maintains an integrated transit itinerary planning service called TranStar. Transit patrons can access the service via telephone and the Internet to plan trips throughout the SCAG region. The TranStar database contains transit route and schedule data from the major transit providers in Los Angeles County, Ventura County, Orange County, San Bernardino County, and Riverside County – virtually all of Southern California except for San Diego County. The CW Rideshare project integrated San Diego transit data into the TranStar database, thus filling a major gap and enabling patrons of public transit to plan trips throughout all of Southern California.

Scoping & Design

The Scoping & Design project is the cornerstone of the Showcase Program and represents roughly eight years of program planning, consensus building, and system development. This project performed the preliminary high-level analysis activities to develop the Showcase Architecture, helped define the work scopes for the other Showcase projects, and designed and built the inter-regional network's Kernels (which help manage the network and provide useful "common services"). Common network services provided by the Kernels include:

Security – This service authenticates a user on the network, and allows the user to be assigned privileges and priorities to receive information and control devices.

Naming – This service provides a "white pages" style directory of the other agencies on the network and the data that each provides. This effectively provides the user with a list of data sources from which to select.

Trader – This service is the "yellow pages" complement to the Naming service.

Publish & Subscribe (P&S) – This service allows agencies to select certain data to "publish" out onto the network based on criteria such as mode, location, and severity. This service is generally used for sharing traffic advisories and event information. The agencies that wish to receive this data can "subscribe" by setting their filter criteria accordingly. In this way, P&S allows agencies to control what information they release, as well as filter and receive only the data that is important to them. Whereas P&S is the method used to distribute asynchronous (i.e., non-continuous) data such as events, a direct peer-to-peer (non-P&S/non-Kernel) connection is used to distribute continuous data such as traffic speeds and transit vehicle locations.

Query – The query service allows an agency to search through data that has been published or archived by other agencies on the network in order to find particular items of interest. For example, a query could be used to find all of the traffic incidents in the last six months that were of major severity. Each agency, however, can limit which of its data is accessible to queries by using the service's built-in security settings.

Location Translation – The Kernel provides software routines that agency centers can utilize to convert location coordinates between "State Plane," "Route/Postmile," and "Latitude/Longitude."

Time Synchronization – The Kernel provides a common clock (based on the Network Time Protocol or NTP) to which centers can synchronize themselves. This is essential for coordinating time-sensitive events such as timing-out traffic advisories and prioritizing system requests.

Failover – The Kernel software resides on four identical and redundant servers that are located throughout the Priority Corridor. There is one server in each of the four Southern California Caltrans Transportation Management Centers (TMCs). When a regional system logs onto the network, it must contact and be "connected" to one of these Kernel servers. If that Kernel server fails for any reason, the regional system must detect the failure and "reconnect" to one of the remaining three servers on the network.

Exhibit 12 – Geographic Location of the Showcase Kernel Servers
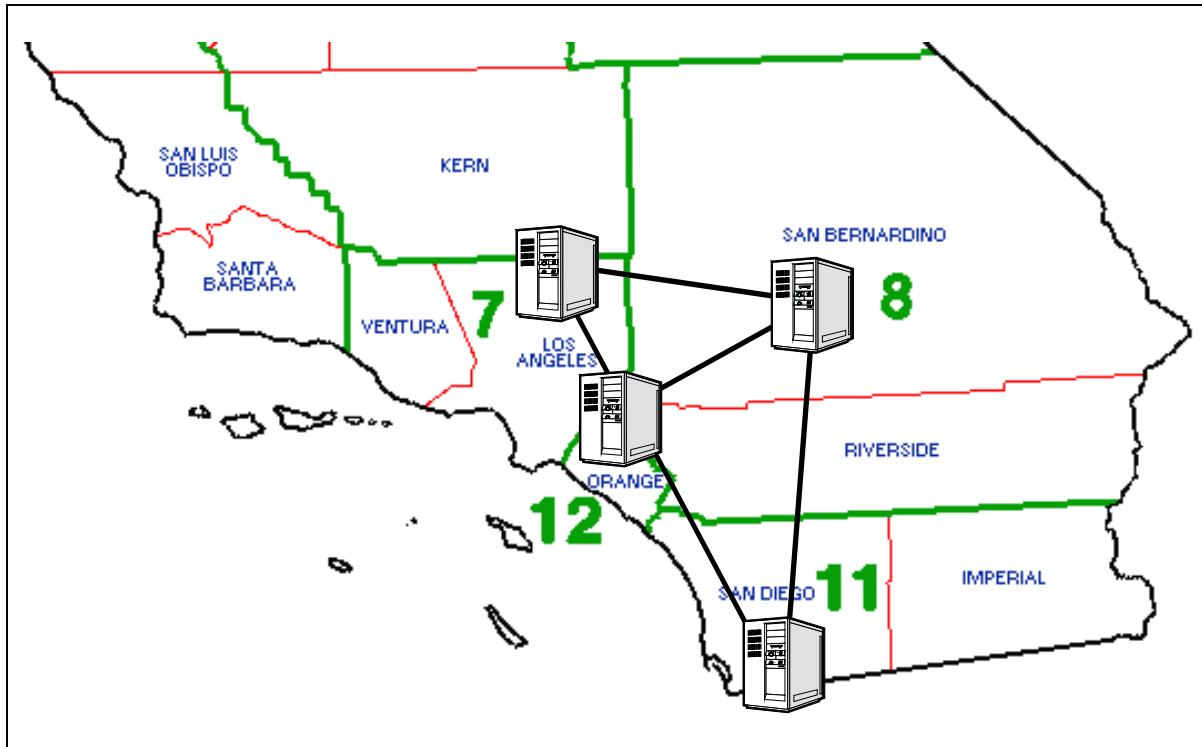
The physical inter-regional communications backbone connecting the Kernels is currently being provided by Caltrans' statewide Wide Area Network (WAN), which consists of Caltrans-owned fiber and additional leased lines. A local agency connects to the Caltrans WAN by installing or leasing lines that run from its facility to a hub at the nearest Caltrans TMC.

4.2   System Performance

There is little to report with regards to the performance of the Corridor-wide systems. Neither the CWSPP nor the CWATIS project was tasked to develop a system. The CW Rideshare system was demonstrated successfully, but is currently not operational due to O&M resource limitations. Although the Scoping & Design project has concluded, the four regional Kernel servers are not in use because currently only the IMAJINE project partners in Los Angeles are integrated with the system. Theoretically, the Kernels would have seen more use over time as systems in other regions were integrated to the network; however, a backwards-compatibility issue with one of the Kernel's third-party COTS software components has made the regional Kernel servers obsolete.

All of Showcase's software (i.e., the Kernels and regional systems) is object-oriented and based on the Common Object Request Broker Architecture (CORBA) and the use of third-party COTS software components called Object Request Brokers (ORBs). CORBA is an open standard, and several vendors produce and sell ORBs. Through a trade-offs analysis of several ORB vendors and products, the Priority Corridor elected to use the Orbix ORB produced by Iona.

Software for the Kernels, TravelTIP, and IMAJINE was developed utilizing Iona's Orbix 3.1 ORB. In early 2002, Iona discontinued supporting Orbix 3.1 when it released its Orbix 2000 product. This would not necessarily be a major issue; however, Orbix 2000 is not backwards compatible with the earlier versions of Orbix. Although Orbix 3.1 still worked, those regional projects that were still in the design phase or very early implementation became reluctant to build their systems using an out-dated and unsupported technology. As a result, the later systems developed using Orbix 2000 are not compatible with the Kernels or other systems that use Orbix 3.1.

The Steering Committee is currently considering a proposal for a more distributed system in which the Kernels' functions and services become resident on the individual regional systems. The Corridor is also considering a transition to an XML-based interface based on the Showcase IDL. The ramifications of this approach are being researched and discussed.

4.3 Costs

4.3.1 Constraints & Assumptions

Since nearly all of the Showcase projects were funded using firm fixed price contracts, the budget information presented here indicates only what was expended by the client agency but not necessarily what it cost the contractor(s) to complete the project.

4.3.2 Project Budget & Estimated Development Costs

The budgets for the four concluded Corridor-wide projects are listed in Exhibit 13 below to provide "ballpark" estimates as to what similar efforts might cost. These budgets include federal, state and any local funds.

Exhibit 13 – Budget for each Corridor-wide Project at Time of Inception

Project	Budget
CWATIS	$475,000
CWATMS	TBD
CWCVO	TBD
CW Rideshare	$125,000
CWSPP	$475,000
Scoping & Design	$4,945,032

4.3.3   Estimated Operations & Maintenance Costs

The major contributors to O&M costs for Showcase systems include power (electricity) and telecommunications. Specifically for the Corridor-wide systems, Exhibit 14 estimates the annual electricity cost impact of the Kernel hardware alone. These estimates were calculated based on the following assumptions:

- An average electricity rate of $0.16 per kW-hour (the actual rate varies seasonally)
- Servers operate 24 hours per day, 365 days per year
- Usage of operator workstations, PCs and monitors is negligible.

Exhibit 14 – Estimated Marginal Annual Electricity Costs for the Kernels

Hardware Item	Model	Power Draw	Power Cost	Est. Annual Cost
4 Kernel Servers	HP K220	1250W	$0.16/kW-hr	**$7,008**

Telecommunications between the four Kernels makes up the greatest portion of their monthly operating cost. Each of the four Kernel servers resides in one of Caltrans' four Southern California TMCs, and Caltrans' statewide WAN provides the inter-regional connectivity between them. Although the WAN is operated and maintained by Caltrans HQIT, usage is not free of charge. Negotiations are ongoing as to how the Priority Corridor will fund its use of the WAN over the long-term.

Exhibit 15 – Monthly and Annual Telecommunications Costs for Inter-regional Network[6]

Description	Monthly Cost	Annual Cost
Use of bandwidth on the statewide WAN.	$10,000	**$120,000**

The costs for regional systems to connect to the WAN and the Kernels are covered by the regional agencies. As of the writing of this report, only the IMAJINE project partners are integrated with the WAN and Kernel v1.0. Please see the IMAJINE Evaluation Report for details of these costs.

4.4   Institutional Impacts and Issues

4.4.1   Impacts to Operations and Maintenance Procedures and Policies

Roughly 15 months after the finalization of the CWSPP's Configuration Management Plan (CMP), the Priority Corridor elected to implement a scaled-back version of it. The Steering Committee found early versions of the plan to be prohibitively rigorous and unsupportable within Showcase's existing resources. It was also unclear how the partner agencies would mainstream and continue to support the CM activities beyond the federally subsidized Showcase Program. Since Caltrans DRI had managed the project, some suggested that Caltrans should entirely support the CM activities. However, by its charter, Caltrans DRI is strictly a research

organization, and may not operate or maintain any systems or infrastructure. For Caltrans to accept this responsibility, CM would have to be transferred out of the Division of Research & Innovation to either Headquarters-Information Technology (HQIT) or the Operations division.

Furthermore, each of the four regions within the Priority Corridor is responsible for its own transportation planning and funding, and the CMP's recommendation to establish a central body to handle CM for the entire Priority Corridor conflicted with this multi-regional framework.

Since the CMP was developed under the management of Caltrans DRI, the Steering Committee determined that the reach of the plan should be scaled back to include only the Corridor-wide components that currently reside with Caltrans, such as the Kernels and inter-regional network. Systems procured by the regional partners would be managed by the respective agencies under their existing policies, unless some other arrangement is made. In this way, the systems would become mainstreamed into the agencies' existing O&M frameworks.

In response to the efforts of the CWSPP, the Priority Corridor Steering Committee formally requested that Caltrans accept responsibility for O&M of the Kernels and the inter-regional "backbone" network (currently provided by the Caltrans WAN). A whitepaper estimating the O&M costs of the Kernels and network was prepared in February 2002 for submission to Caltrans management. Although the equipment is currently installed at Caltrans facilities, a formal decision has not yet been made whether Caltrans will accept this responsibility for the long-term.

4.4.2   Impacts to Staffing/Skill Levels and Training

Decisions on where to assign responsibilities and locate new equipment have been designed to minimize the impacts to the participating agencies. For example, the four Kernels were intentionally installed at the Caltrans TMCs in part due to the availability of technical staff with the appropriate skill sets. Caltrans has a long history of developing and maintaining innovative technologies, so it has developed the staff, skill sets, and infrastructure to accommodate equipment such as the Kernels.

4.4.3   Impacts to the Competitive Environment

The Showcase Architecture and IDL are described across many documents and hundreds of pages. As the Scoping & Design project's sponsor agency, SANDAG currently holds this documentation on behalf of the Priority Corridor and may release it to subsequent contractors.

Competing contractors have argued that the documentation may be inaccurate or incomplete, and, therefore, insufficient for anyone else to understand how to upgrade, modify, or integrate with Showcase systems. Whether this is a valid complaint remains unconfirmed and requires further study. Validation of the documentation could require an examination of various projects' software source code to confirm interfaces, object definitions and relationships, event sequencing, etc.

4.4.4 Impacts to Local Planning Processes, Policy Development, and the Mainstreaming of ITS

Physically and institutionally, one of the greatest accomplishments of the Showcase Program is its development of system interface standards for the entire Priority Corridor through the Scoping & Design effort. Similar to the national effort on NTCIP, adoption of these standards will help promote interoperable systems that enable greater information sharing, improved agency coordination, and reduced costs over time.

Perhaps more importantly, Showcase laid an institutional foundation that helps to mainstream ITS across the Priority Corridor. Through this experience, stakeholders from the four Southern California regions have had the opportunity to face and resolve critical institutional issues and establish precedents for the Priority Corridor's future ITS projects. Some of these critical issues include, but are not limited to:

- System and information security
- System reliability
- Policies regarding shared control of field equipment such as CCTVs and CMSs
- Software ownership and the treatment of intellectual property rights
- Delegation of operations and maintenance responsibilities (including funding).

Due ultimately to the regional planning and funding structure within the Priority Corridor, the Steering Committee determined that management of regional ITS should be mainstreamed and handled by the respective regional partners. This has led to the development of four independent (but "Showcase-compliant") regional ITS networks in Southern California that could eventually be inter-connected by an inter-regional communications "backbone" possibly provided by Caltrans.

Lastly, with the completion of the Showcase Program, the Priority Corridor Steering Committee will not dissolve, but continue to meet in a new role. The Steering Committee is a unique body that draws together agencies from across all of Southern California to discuss and coordinate on ITS issues. No other body in the State of California brings together so many agencies and stakeholders. As a result, this body will transition from the Program's Steering Committee to meeting as the "Southern California ITS Forum."

4.5 Traveler and Transportation Information Management/User Acceptance

4.5.1 Extent of Regional and Inter-regional Transportation and Traveler Information Integration Between Agencies

There are few examples of integration between Corridor-wide projects. The Kernel is an enabling technology that provides "common services," as well as an inter-regional communications "backbone." As of the writing of this report, only the four IMAJINE project partners (MTA, Access Services Inc., City of South Gate, and Caltrans District 7) in the Los Angeles region are integrated with the Kernel version 1.0 and the inter-regional Showcase Network.

The CW Rideshare system does not make use of the Showcase Network. During an early demonstration, data was successfully transmitted via the Internet, but the system is currently not in use due to a lack of O&M funding. As part of the CW Rideshare project, a report was prepared to investigate what it would take to port the data exchange process from the Internet to the Showcase Network.

4.6 *Transportation System Impacts*

There are no Transportation System Impacts from the Corridor-wide projects to report. The CW Rideshare system was successfully demonstrated, but is not currently operational. The CWATMS and CWCVO projects have not yet kicked off. CWSPP studied Corridor-wide configuration management, but was not intended to develop a system. Although the Kernels were successfully completed, they are an enabling technology and do not directly impact the transportation system.

5 San Diego Region Projects

This chapter summarizes the evaluation findings from the San Diego projects. This chapter addresses those projects' system performance, costs, institutional impacts, utilization, and transportation system impacts.

5.1 Overview and Technical Descriptions

The Showcase Program includes five San Diego projects:

▸ InterCAD
▸ Intermodal Transportation Management Center/System (IMTMC/S)
▸ Mission Valley Advanced Transportation Management & Information System (ATMIS)
▸ Traffic Signal Integration (also known as Regional Arterial Management System, RAMS)
▸ Transit Management System (or Regional Automatic Vehicle Location, RAVL)

Two of these projects have been concluded to-date. They include InterCAD and Mission Valley ATMIS. The other three projects are well underway and at various stages of completion.

InterCAD

San Diego InterCAD – the San Diego Regional Computer Aided Dispatch (CAD) Interconnect project – is a Showcase Early Start Project originally developed to facilitate improved highway incident management in San Diego County. The system would enable rapid coordination of interagency response to multi-jurisdictional incidents. More specifically, InterCAD would improve the transfer of time-critical and incident–related information between selected operator positions within the participating agencies' communication centers. InterCAD would provide a fast, secure data messaging and electronic mail system between Computer Aided Dispatch (CAD) supervisors at emergency service, first response, law enforcement, and transportation agencies. The design involves a defined set of messages that all CAD systems can be programmed to read and send. InterCAD did not seek to integrate agency systems, but only to facilitate their interconnection through system-independent messaging.

IMTMC/S

The existing primary transportation management systems in the region focus on freeways and are operated by Caltrans District 11 from the regional Transportation Management Center (TMC). The IMTMC/S expands upon these systems and integrates the modal management systems to support regional intermodal and multimodal functions. Phase 1 of the IMTMC/S project has evolved to plan and develop user requirements for the other San Diego projects, much like Scoping & Design (Phase 1) did for the other Showcase projects.

Exhibit 16 – San Diego Regional ITS Network
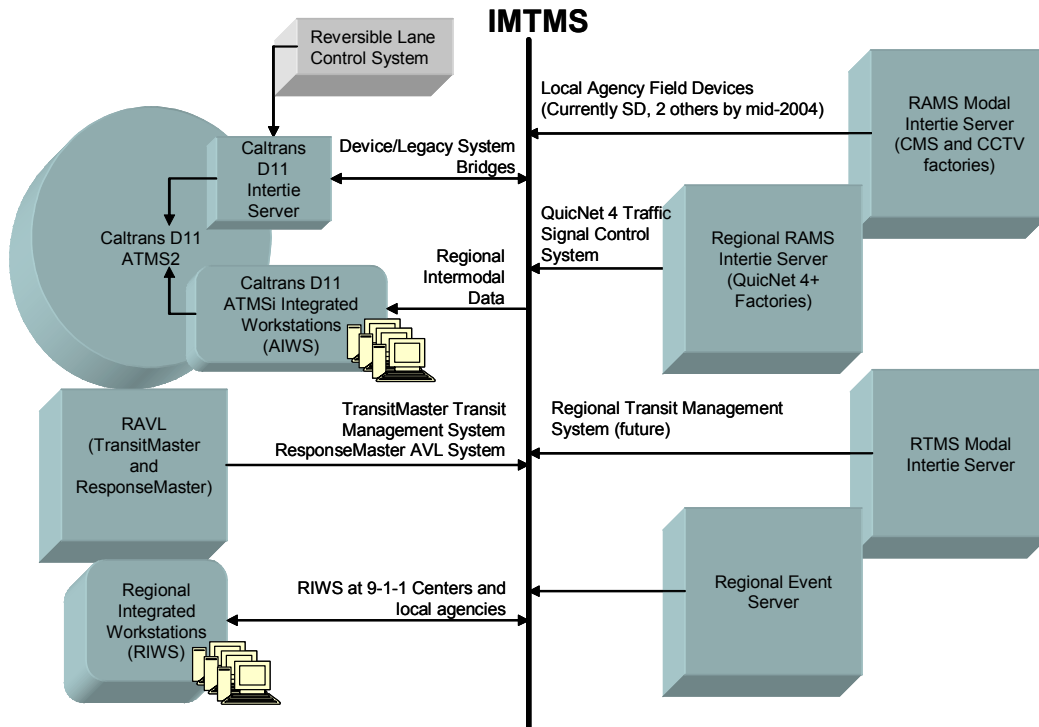
Mission Valley ATMIS

The Mission Valley Advanced Transportation Management and Information System (ATMIS) project is the Showcase Program model for a cooperative interagency event management system. The project goal was to demonstrate the benefits of an Integrated Workstation (IWS) with functionality directed at reducing traffic congestion into and around Qualcomm Stadium in San Diego's Mission Valley. The IWS functionality enables travelers to make route decisions by providing real time traffic information in the vicinity of the stadium through the use of changeable message signs (CMS) and highway advisory radio (HAR). Additionally, the system allows traffic management functions to be shared and coordinated by personnel at the City of San Diego Transportation Operations Center (TOC), the Caltrans District 11 Transportation Management Center (TMC), and the San Diego Stadium Event Management Center (EMC), which is jointly operated by the San Diego Police Department (SDPD) and Qualcomm Stadium staff. Traffic management applications include shared use of closed caption television (CCTV) cameras, remote traffic signal timing adjustments, and shared control of CMSs along the primary routes into the stadium.

Regional Arterial Management System (RAMS)

The RAMS project establishes a coordinated management system for traffic signals on arterial streets and roadways in the San Diego region. The RAMS project is comprised of two tiers of development. Tier 1, the Regional Traffic Signal Integration Project, is funded by the Showcase Program and is managed contractually by SANDAG.

The primary project goal is to coordinate traffic signal systems across jurisdictions so that traffic flows are optimized along inter-jurisdictional arterial corridors and roadways.   The RAMS project provides a venue for developing, approving and deploying multi-jurisdictional traffic signal timing plans for inter-jurisdictional arterial corridors. Currently, each jurisdiction (the County, various local cities, and Caltrans) manages their traffic signals and associated hardware and software independently of other neighboring or regional jurisdictions. RAMS will allow all local agencies the opportunity to coordinate their existing traffic signal management activities through the use of common hardware, software, and data definitions and exchange protocols. This application will be based on an upgrade of existing traffic signal control system software (QuicNet/4) currently in use by many jurisdictions in the San Diego region. Many local agencies have been involved in the planning, design and deployment of RAMS. The system requirements and overall design have been developed cooperatively by a group of agency traffic engineers and signal system operators who also are members of the San Diego Traffic Engineers Council (SANTEC). This council serves as an advisory group for agency transportation engineering issues in the San Diego region.

Regional Automated Vehicle Locator (RAVL)

The RAVL project represents the initial "proof of concept" phase of the Regional Transit Management System (RTMS). Both RAVL and RTMS were designed to interface with the San Diego Intermodal Transportation Management System (IMTMS), which integrates regional modal management systems for freeways, arterials, transit, and traveler information.

The RAVL project consists of two separate efforts: 1) San Diego Freeway Service Patrol (FSP) & Traffic Management Team (TMT), and 2) San Diego Transit Management System Demonstration. Only the San Diego Transit Management System Demonstration was funded through Showcase, and it consists of a CAD/AVL implementation on four transit services:

- Airport Flyer (operated by ATC Vancom)
- Inland Breeze (operated by NCTD)
- Coaster commuter rail (operated by NCTD), and
- Poway transit services (operated by Poway Laidlaw)

The Showcase-funded portion of the project equipped Airport Flyer, Inland Breeze and Poway buses with on-board computers to support RAVL functions such as vehicle tracking and data communications. Seven Airport Flyer buses have been equipped with emitters and integration devices. Traffic control components for a signal priority demonstration were installed by the City of San Diego along the Harbor Drive demonstration corridor to demonstrate signal priority and stop enunciation functions. The Coaster Commuter Rail fleet is equipped with on-board computers to support RAVL functions such as vehicle tracking and data communications.

5.2 *System Performance*

In the case of the San Diego projects, only InterCAD and Mission Valley ATMIS are concluded.

The InterCAD system was tested between four participating agencies and test messages continued to be pushed out by the Caltrans District 11 TMC for a short term in late 1999. The continuation of test messages was intended to assist participating agencies in becoming familiar with, and accustomed to, using the InterCAD system. During this test period, there was no evidence of any system failures. The InterCAD system was subsequently taken offline due to law enforcement's concerns over the security of the network.

The Mission Valley ATMIS experienced no major system failures during the evaluation period, but not all aspects of the system were available for operation during the period of the evaluation. A fiber optic cable link between the San Diego City TOC and Qualcomm Stadium's EMC was damaged by construction activities during the period of the evaluation. Additionally, the City performed a fiber optic cable upgrade during this period, which further delayed the reestablishment of communications between the workstation at the stadium and the workstations at TOC and TMC. The workstations at all three locations were operational during the evaluation period; however communication was only available between the TOC and the TMC.

5.3 *Costs*

5.3.1 Project Budget & Estimated Development Costs

Approximately $681,000 was made available for the InterCAD Phase 2 contract. The project's contractor indicates that additional labor and resources were applied over and above the allocated budget so that unforeseen delays and institutional issues could be overcome to bring the project to completion. The system developer's estimate of additional unbudgeted costs for InterCAD Phase II is approximately $127,000.

The IMTMC/S project is being conducted under a task order contract for $8,402,209 and was funded by a variety of grants derived from federal, state, and local sources. $2,560,000 of the IMTMC/S budget seems to have been derived from the Showcase Program.

The RAMS project derives funds from several sources, including the Showcase Program. Of the project's $1,625,000 budget, $1,376,000 comes from Showcase.

A total of $2,820,957 was spent on the entire RAVL project, including both the FSP/TMT effort and the San Diego Transit Management System Demonstration.

Project budgets for the San Diego projects are summarized in Exhibit 17.

Exhibit 17 – Budget for each San Diego Project

Project	Budget
InterCAD Phase 2	$681,000
IMTMC/S	$8,402,209
Mission Valley ATMIS	$452,412
RAMS	$1,625,000
RAVL	$2,820,957

5.3.2 Estimated Operations & Maintenance Costs

InterCAD Phase II was tested between four participating centers using PacBell's SMDS network. Had the system continued to be operated using this service, the estimated total annual O&M cost might have been $18,889. The InterCAD system was designed to improve the transfer of time-critical and incident–related information between existing operator positions within the participating agencies' communication centers, so there would not be an increase in labor costs. InterCAD's utility costs include electricity (for powering the IMX terminals) and telecommunications (for interagency communications). Exhibit 18 estimates the annual electricity cost impact that could be produced by InterCAD hardware. These estimates are based on the following assumptions:

‣ An average electricity rate of $0.16 per kW-hour (the actual rate varies seasonally)
‣ Terminals and monitors operate 24 hours per day, 365 days per year

Exhibit 18 – Estimated Marginal Annual Electricity Costs for InterCAD

Hardware Item	Model	Power Draw	Power Cost	Est. Annual Cost
6 MQM Servers/IMX Terminals	Sun Ultra 5/10	250W ea.	$0.16/kW-hr	$2097
6 typical 21" color monitors	Various	135W ea.	$0.16/kW-hr	$1132
				$3229

InterCAD's telecommunications needs were provided by PacBell's 56 Kbps SMDS network. The cost to lease this service is provided in Exhibit 19.

Exhibit 19 – Monthly and Annual Telecommunications Costs

Description	One-time Installation Fee	Ongoing Monthly Cost	Ongoing Annual Cost
Leased 56Kbps data connection.	$10,768	$1305	**$15,660**

Exhibit 20 combines the estimated annual costs for electricity (from Exhibit 18) and telecommunications (from Exhibit 19) to arrive at InterCAD's estimated total annual utility cost.

Exhibit 20 – Total Estimated Annual Marginal Cost for Operating InterCAD

Cost Component	Est. Annual Marginal Cost
Electricity	$3229
Telecommunications	$15,660
TOTAL	**$18,889**

However, the operation of the Mission Valley ATMIS is primarily a function of the City of San Diego TOC manager in cooperation with Caltrans and Qualcomm stadium during special events. The system is only operated periodically on an as-needed basis. Full time daily operation of the system has not been necessary as of the completion of this report.

Labor costs for the support of the Mission Valley ATMIS have been absorbed as part of the responsibilities of existing staff at the locations where the workstations are currently deployed. Telecommunications service is provided by existing city-owned fiber optic lines, which are funded and maintained through the City's overall facilities budget. There are no additional telecommunications costs specific to this project. Annual electricity costs to run the three workstations is estimated at $477.

5.4   Institutional Impacts and Issues

5.4.1   Impacts to Operations and Maintenance Procedures and Policies

No O&M procedures or policies regarding InterCAD have been developed at this time, but the project team recognizes the benefit of developing such procedures and policies early in a project's lifecycle as part of a Concept of Operations (ConOps) document.

In response to this lesson learned during InterCAD, the Mission Valley ATMIS team developed an Event Traffic Management Operations Procedures (ETMOP) document to clearly define the roles and responsibilities of the three partner agencies, including guidance on the shared use of field devices such as cameras and CMS.

5.4.2   Impacts to Staffing/Skill Levels and Training

Both InterCAD and Mission Valley ATMIS were intended to provide new or added functionality to existing operator positions at the participating agencies, thus fitting in with existing staff levels. The systems provide intuitive, Windows-like graphical user interfaces, and the system developers provided system operation training during their respective projects.

5.4.3   Impacts to Local Planning Processes, Policy Development, and the Mainstreaming of ITS

The San Diego region recognizes the benefits to be gained by better coordinating its technology projects under a regional ITS architecture. Prior to the Southern California Priority Corridor's formation in 1995, each of the four regions has maintained an ITS Strategic Planning Team consisting of representatives from Caltrans, CHP, the regional planning organization, local traffic departments, local law enforcement, and transit providers. SANDAG, the San Diego regional planning organization, continues to seek the participation of additional regional stakeholders in order to improve inter-agency coordination and help mitigate complications and redundancies. The San Diego ITS Strategic Planning team meets on a monthly basis to confer on plans as well as monitor the progress of existing projects.

5.5   *Traveler and Transportation Information Management/User Acceptance*

5.5.1   Extent of Regional and Inter-regional Transportation and Traveler Information Integration Between Agencies

The current Phase II InterCAD system is non-operational, but the San Diego region has not abandoned the goal of providing such functionality sometime in the future. Overall, the introduction of InterCAD as a new means of communicating transportation information was well received by agency management and staff. Prior to the installation of the InterCAD system in participating agency operations centers, various types of regional and inter-regional transportation information were exchanged by communicating agencies based on need, availability, and each agency's information dissemination policy.

5.6   *Transportation System Impacts*

At this time, there are no transportation system impacts to report from the San Diego region.

6 Los Angeles/Orange County/Inland Empire Region Projects

This chapter summarizes the findings from the Los Angeles, Orange County, and Inland Empire project evaluations. This chapter addresses those projects' system performance, costs, institutional impacts, utilization, and transportation system impacts.

6.1 Overview and Technical Descriptions

A total of six Showcase projects were identified for the Los Angeles/Orange County/Inland Empire regions:

‣ Inter-modal and -Jurisdictional Integrated Network Environment (IMAJINE)
‣ Los Angeles/Ventura Regional ATIS (LA/Ventura ATIS)
‣ Intermodal Shift Management System (Mode Shift)
‣ TravelTIP
‣ Orange County Model Deployment Initiative (OCMDI)
‣ Fontana-Ontario ATMIS

All six of these contracts have been concluded, and are described below.

IMAJINE

IMAJINE enables operators and systems at Access Services Inc. (ASI), Caltrans District 7, Los Angeles County Metropolitan Transportation Authority (MTA), and the City of South Gate exchange information for better-coordinated service.

The IMAJINE system was designed to provide a particular benefit for each project partner. As the local fixed-route transit provider, MTA uses the system to provide up-to-date transit routes, schedules, and fare information. ASI, the region's contracted paratransit service provider, uses MTA's information to coordinate service and prepare transit itineraries for patrons over the phone. Caltrans District 7 provides information regarding highway events, including freeway condition data, camera images, and current CMS messages. South Gate uses the highway incident information from Caltrans District 7 to automatically execute response plans that adjust traffic signal timings along major arterial feeder and diversion routes. In the future, the system might also be used to provide traffic signal priority to MTA buses equipped with automatic vehicle location (AVL) technology.

Los Angeles/Ventura ATIS

LA/Ventura ATIS provides the Los Angeles/Ventura region another critical element towards the achievement of an integrated ITS. The project built upon and enhanced the IMAJINE workstation software and integrated additional agencies with the regional ITS network.

Mode Shift

Mode Shift provides accurate, real-time traveler information for a major subregion of Los Angeles County, with comprehensive itinerary functionality for vehicular and transit trips. Mode Shift provides the following specific information to the end user:

- Real-time traffic conditions for freeways and arterials
- Real-time event information for freeways and arterials
- Transit schedules and fare information for rail and bus
- Access to other travel-related data, such as paratransit service

Mode Shift provides detailed trip itinerary information for multiple transportation modes, allowing the traveler to make more informed travel choices. Travelers can compare estimated travel times for both private auto- and public transit-based trips and then select the most attractive alternative.

TravelTIP

Orange County's TravelTIP system provides real-time traveler information regarding traffic congestion and roadway "events" to the general public via the Internet and a Highway Advisory Telephone (HAT) service. Although there are other traveler information systems in the region that provide real-time traveler information for the highways, TravelTIP is unique in that it provides real-time information for both highways and many major arterials as well.

OCMDI

The OCMDI extends the region's traveler information infrastructure by developing a hardware/software system and instituting the Traveler Advisory News Network (TANN). Technologically, the OCMDI developed a single interface point through which a wide variety of transportation data is gathered from an assortment of public agencies and is made available to private sector Information Service providers (ISPs). The ISPs then use the data to provide traveler information to the public via a wide range of products, including in-vehicle units, hand-held devices, pagers, Internet/Intranet, cable TV, etc. Institutionally, TANN is the service and administrative body that manages this public-private interface system. TANN administrators handle the business and revenue-sharing issues, which include registering ISPs, obtaining and managing corporate sponsorships, etc.

Fontana-Ontario ATMIS

The Fontana-Ontario Advanced Transportation Management & Information System (ATMIS) provides state-of-the-art transportation management and traveler information for a portion of the Inland Empire Region. The project installs a new Traffic Management Center (TMC) in the City of Fontana, as well as additional cameras and changeable message signs (CMSs) in the Fontana and Ontario areas. Traveler information, including video images and incident advisories, is provided on a website and the City of Fontana's community access cable television channel.

6.2   *System Performance*

6.2.1   System Reliability, Availability, Compatibility, and Scalability

These six project systems are at various levels of operation. Although successfully tested and demonstrated on several occasions, neither IMAJINE, LA/Ventura ATIS, OCMDI, or TravelTIP are in full day-to-day operation. Mode Shift and the Fontana TMC are operational and have not reported any major system anomalies.

6.2.2   Impact of Showcase Integration on Project Deployment and System Performance

The four Kernels comprise the centerpiece of the Showcase Architecture, and delays with their development had a rippling effect on IMAJINE, TravelTIP, and the OCMDI. The Kernels authenticate (identify and approve) agency centers that wish to log on to the Showcase Network, as well as provide additional common services such as location translation, "yellow pages," publish & subscribe, and query. Regional systems that wish to exchange information across the inter-regional Showcase Network must contain software to communicate and interface with the Kernels.

As shown in Exhibit 21, the Kernels were developed in parallel with other Early Start projects such as IMAJINE and TravelTIP. This situation of concurrent development provided an excellent opportunity for constructive feedback between the projects, but also slowed development of all three as design details were shared and consensus was built.

Exhibit 21 – Joint Timeline of the IMAJINE, TravelTIP and Kernel Early Start Projects
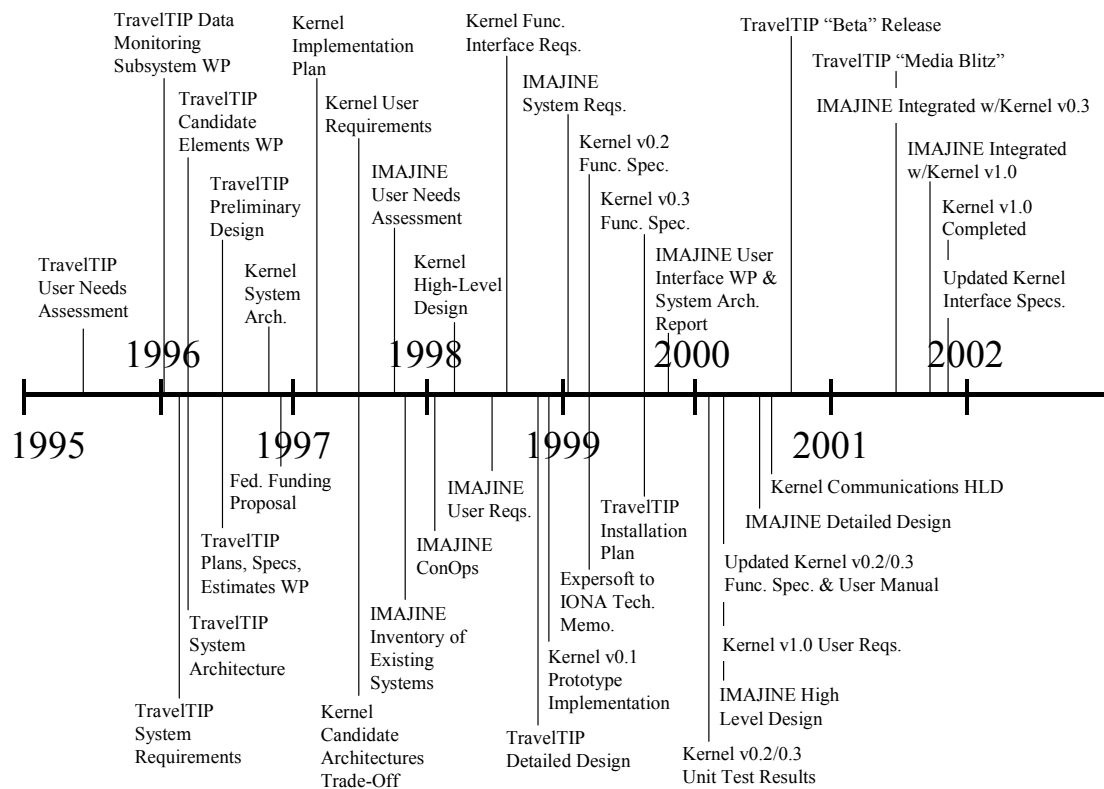
Delays in the development of the Kernels and the release of the Showcase IDL prompted TravelTIP to develop its own "Kernel-lite." Although Kernel-lite succeeded as a stop-gap measure to help complete the TravelTIP project, it did not allow for the system to integrate with the Showcase Network or provide data to other systems such as IMAJINE and the OCMDI. With no TravelTIP data available, the OCMDI chose to defer its own integration to the network.

In addition, a dispute between contractors over the completeness and accuracy of the Showcase IDL (the detailed rules for the Showcase systems to interface with each other) resulted in the Fontana-Ontario ATMIS not integrating with the Showcase Network.

In the Los Angeles/Ventura region, projects such as IMAJINE and LA/Ventura ATIS helped integrate the following public agencies:

- Caltrans District 7
- Los Angeles County Department of Public Works (LACDPW)
- Los Angeles County Metropolitan Transportation Authority (MTA)
- Los Angeles (City) Department of Transportation (LADOT)
- City of South Gate

As a result of the seed planted by Showcase, the MTA is pushing forward with integration efforts in the Los Angeles region through its own (non-Showcase) "Regional Integration of ITS" project

(RIITS). RIITS will help extend the network to additional agency partners in the Los Angeles region.

6.3   Costs

6.3.1   Project Budget & Estimated Development Costs

The individual budgets for the six projects in the Los Angeles/Orange County/Inland Empire region are listed below:

Exhibit 22 – Budget for each LA/OC/IE Project

Project	Budget
IMAJINE	$3,075,000
LA/Ventura ATIS	$1,531,156
Mode Shift	$1,319,706
TravelTIP	$4,676,462
OCMDI	$2,475,000
Fontana-Ontario ATMIS	$2,568,000

IMAJINE's work scope originally only called for integration to Kernel version 0.3. The final budget shown above reflects an increase of 2.5% in order to cover the added task of integrating IMAJINE with Kernel version 1.0.

6.3.2   Estimated Operations & Maintenance Costs

Each region has its own approach for funding O&M, and the costs vary widely from system to system. Because IMAJINE's O&M costs are funded by each respective partner agency, the project team designed the system with low operating costs in mind. This design feature is successfully demonstrated by an estimated annual O&M cost per agency of between $1932 and $2651 (this cost covers power consumption and telecommunications). By comparison, TravelTIP's electricity and telecommunications costs are almost entirely covered by OCTA at an estimated annual O&M cost of roughly $72,000-$75,600.

In addition to the ITS O&M costs borne by the public agencies, the Showcase Program also provided a unique opportunity to study the operations of a private-sector transportation information broker. The Traveler Advisory News Network (TANN), which is managed and administered by the Southern California Economic Partnership (The Partnership), is a non-profit for public benefit 501 (c) 4 California Corporation. TANN received seed funding from the OCMDI project to begin operation as a broker of transportation information between public agencies and other private sector Information Service Providers (ISPs).

Initially, TANN only provided its "data publishing" service, which essentially provides raw data with minimal processing to its ISP affiliates. However, with the burst of the dot-com bubble, the nature of the ISPs changed and TANN's business model evolved to include "map publishing" as

well as "data publishing." TANN was thus introduced as a branded retail source of information available via the Internet directly to the consumer. In addition to the dot-com-like start-up companies who want raw data to power their new and innovative technology products, many of TANN's current affiliates are well-established media outlets that need to provide traffic information in order to stay competitive in their market. TANN uses the public traffic and incident data that it receives from agencies to provide a finished real-time traffic flow map for use and rebroadcast on these affiliates' websites and television programs. This creates an extensive transportation information distribution network helping to bring traveler information into the homes of everyday commuters.

TANN's original business model envisioned profit-sharing among the data providers to help defray the costs of O&M and help support the traveler information market. The model anticipated revenues from advertising at a $40 cost per thousand viewers (CPM) rate and subscribers paying $5.00 per month. Unfortunately, the CPM rate dropped to $2.50 with an over supply of advertising space inventory. Subscribers would not pay the $5 rate and the traveler information market remains extremely small. As a result, the business has yet to make a profit. TANN estimates that the minimum annual O&M cost to operate the stand-alone service is about $500,000 when including all utility costs and staff costs.

TANN utilizes a total of five servers to operate its "data publishing" and "map publishing" services. The "TANN Server" captures raw data from public agencies as well as publishes maps and formatted data out to ISPs and other affiliates. TANN leases this server hardware from XO Communications, which also hosts the server and provides 24/7 support. This service costs a fixed $12,000 per year. Four other servers reside at TANN's facility in Diamond Bar, California. TANN pays $900 per month for T1 communications access at this site, resulting in an additional annual cost (power and telecommunications) of about $11,300. The total annual O&M cost for all five servers is $23,300.

6.4   Institutional Impacts and Issues

6.4.1   Impacts to Operations and Maintenance Procedures and Policies

This subsection shows the contrast between the Los Angeles region and Orange County. As a policy, the Los Angeles County MTA will not fund the O&M costs of other agencies. Participation by other agencies in the IMAJINE project was contingent upon this condition. As a result, each partner agency agreed to program the necessary funding to cover O&M of its system.

By contrast, OCTA covers the TravelTIP O&M costs for the participating local agencies. Since limited funding at most of the local partner agencies would have otherwise prohibited their participation in the project, their participation was contingent upon there being no cost to them.

Under separate MOUs with each of the individual local partner agencies, OCTA agreed to cover all of the following project-related local agency costs:

‣ Remote Workstations (hardware and software)
‣ System installation
‣ Maintenance
‣ Data communications costs between RWSs and the TravelTIP Server (eventually located at Caltrans District 12)

After the TravelTIP system had been accepted and the project's O&M demonstration period had expired, the system was relocated from the system developer's facility to the Caltrans District 12 TMC. Although OCTA managed the development of the system, the Caltrans District 12 TMC was selected to host it because of its familiarity with similar technologies and the availability of greater communications bandwidth.

Under the terms of its MOU with OCTA, Caltrans District 12 hosts (provides space, electricity and network connection for) the TravelTIP hardware (application server, web servers, and HAT server) and provides only minor maintenance support (re-booting hardware, if necessary). All other responsibilities, including maintenance and providing the funding for operations (electricity, communications, etc.), rest with the OCTA.

6.4.2 Impacts to Staffing/Skill Levels and Training

The agencies in Southern California are constrained by their existing budgets and staff levels. By necessity, most of the Showcase systems were developed either to run autonomously with little or no human intervention, or to supplement existing operator positions that already had assigned staff.

6.4.3 Impacts to the Competitive Environment

The OCMDI provided a unique look at the management of traveler information by the private sector. Because the media market is very competitive, TANN enters into limited exclusive agreements regarding withholding public data from other ISPs. Although TANN may agree to provide its services exclusively to only one particular media affiliate in one metropolitan market, this does not prevent it from making a different deal in another metropolitan market. For example, although TANN may agree to provide its map only to the ABC affiliate in Los Angeles, the agreement would only apply to that market and TANN would be free to negotiate a different deal with any other media company elsewhere (e.g., NBC, CBS or a cable television provider in San Francisco, Seattle, Chicago, etc.).

However, agencies are not required to distribute their data through TANN, thus eliminating the possibility of a monopoly. TANN must negotiate agreements with each agency, and, ultimately, an agency may choose to provide its data to the private sector by some other channel, perhaps directly to the ISPs. This maintains the potential for other data brokers to compete with TANN.

6.4.4   Impacts to Local Planning Processes, Policy Development, and the Mainstreaming of ITS

As stated previously, the Priority Corridor's four regions are pursuing the development of their own respective regional ITS networks, which may eventually be tied together by an inter-regional communications backbone. The Los Angeles and San Diego regions are leading this approach.

In the Los Angeles region, IMAJINE helped set the foundation for further ITS development and took the first step in a much larger, multi-stage regional ITS effort that involves several planned and currently ongoing projects, including:

 ‣ Regional Integration of ITS (RIITS) project – This ongoing, non-Showcase project by the MTA develops an ITS network for the Los Angeles/Ventura region, as well as helps institutionalize associated administrative functions such as configuration management. RIITS binds all of the region's other ITS projects together.

 ‣ Information Exchange Network (IEN) project – This ongoing, non-Showcase project by the LACDPW integrates and coordinates the traffic signal systems of various cities throughout Los Angeles County. Once completed, the IEN will become a significant source of data regarding arterial traffic conditions throughout the county.

 ‣ Los Angeles/Ventura Regional ATIS (LA/Ventura ATIS) – This project was funded through Showcase and managed by the MTA. It built upon and enhanced the IMAJINE software and hardware by utilizing the latest technology, adding features and functionality, and integrating additional agency partners onto the regional network. The additional partners/centers include LADOT's ATSAC, SCAG's TranStar database, and LACDPW's IEN.

 ‣ Mode Shift project – This project was funded through Showcase and managed by Caltrans District 7. Mode Shift developed a website that helps travelers plan their trips either by car or public transit. Users enter an origin, destination and other travel information, and the system calculates the best routes via both personal automobile and public transit. The goal is to show users that transit is sometimes a better mode of travel.

These projects, along with others, are shown as part of the MTA's Long Range ITS Master Plan in Exhibit 23.

Exhibit 23 – Systems to be Connected by the Los Angeles Regional ITS Network
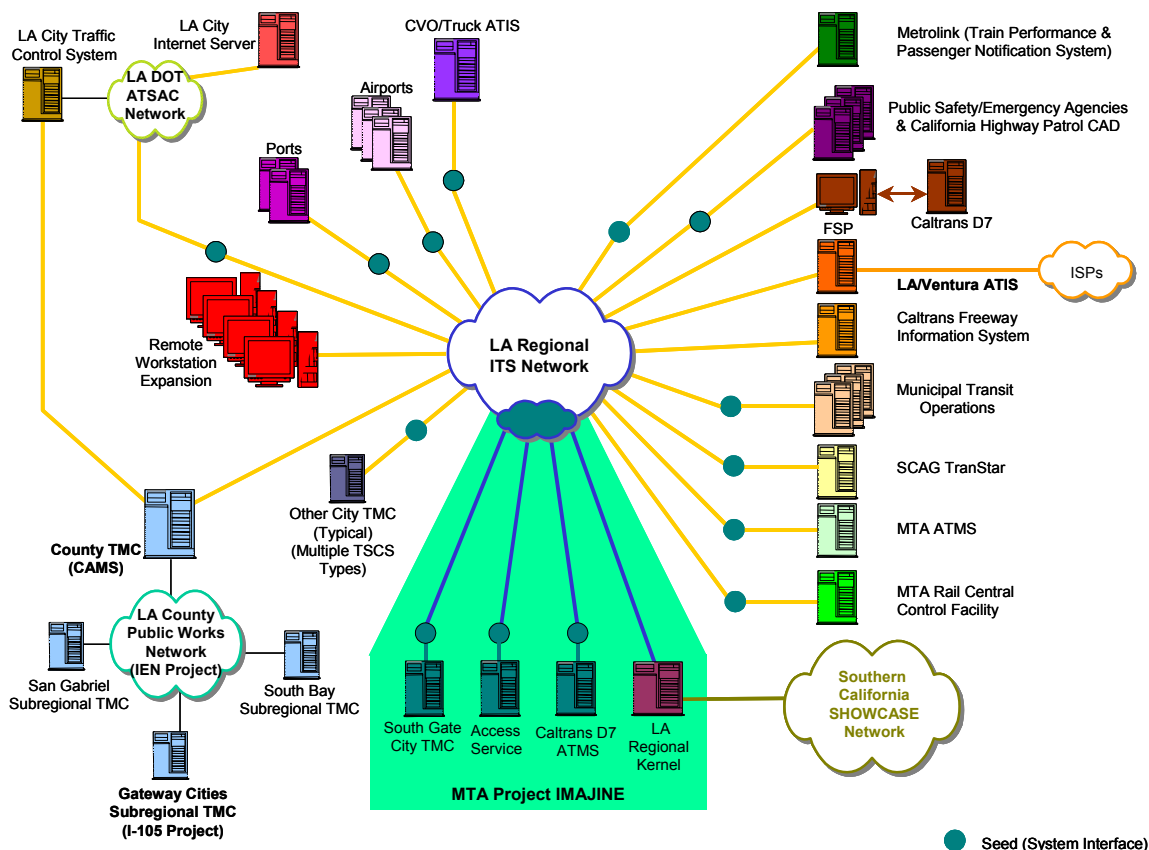
6.5   Traveler and Transportation Information Management/User Acceptance

Data on the public's use of the TravelTIP website is available for the system's eight months of operation immediately following its "media blitz" on June 11, 2001. The usage data is drawn from automatically collected server statistics and is based on the number of web page requests. These statistics do not necessarily indicate the number of unique users or the number of distinct user sessions.   For example, TravelTIP's traffic map refreshes automatically approximately every 60 seconds, and each refreshed page is counted as a new page request or "hit." Use of the traffic page as a computer screen background or "wallpaper" could result in hundreds of additional page hits.

Exhibit 24 shows the number of monthly page hits to TravelTIP's traffic and transit pages over the eight months following the media blitz on June 11, 2001. As the exhibit shows, use of the site was greatest immediately following the media blitz and decreased rapidly over the following months.

Exhibit 24 – TravelTIP Website Usage, by Month
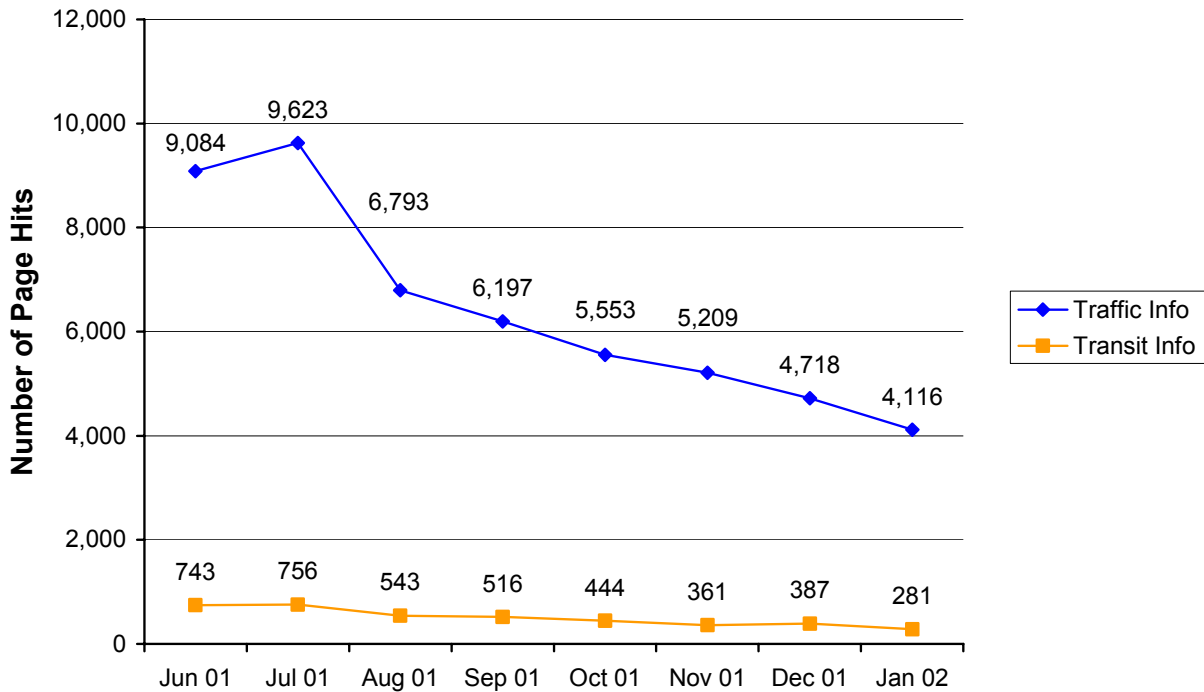
The June 2001 numbers reflect only 15 days of data, starting from June 11 (data for June 17 and June 27-30 were not available for this report). July 2001 page hits are estimates based on available data.

The average hits-per-month to TravelTIP's Traffic page was 6,412 during the eight-month period, while the average hits-per-month to the Transit page was 504. The resulting ratio of Traffic page hits to Transit page hits is roughly 12.7 to 1. This might be explained by two factors:

1. TravelTIP's transit page provides a list of links to existing local transit information web sites. Once identified, users can "bookmark" and access these sites directly without using TravelTIP.

2. The vast majority of Orange County commuters travel by automobile, which results in a greater demand for traffic information as compared to transit information.

The average number of TravelTIP page hits per day, including both the traffic and transit pages, was much higher in June and July (daily average of 439) than in the later six months (daily average of 191). In particular, the number of page hits on June 12 (i.e., the day after the media blitz) is estimated at 1,194 – almost five times higher than the overall average daily number of page hits of 241 during the eight-month period.

Exhibit 25 shows the average daily number of page hits to TravelTIP, by day of week.

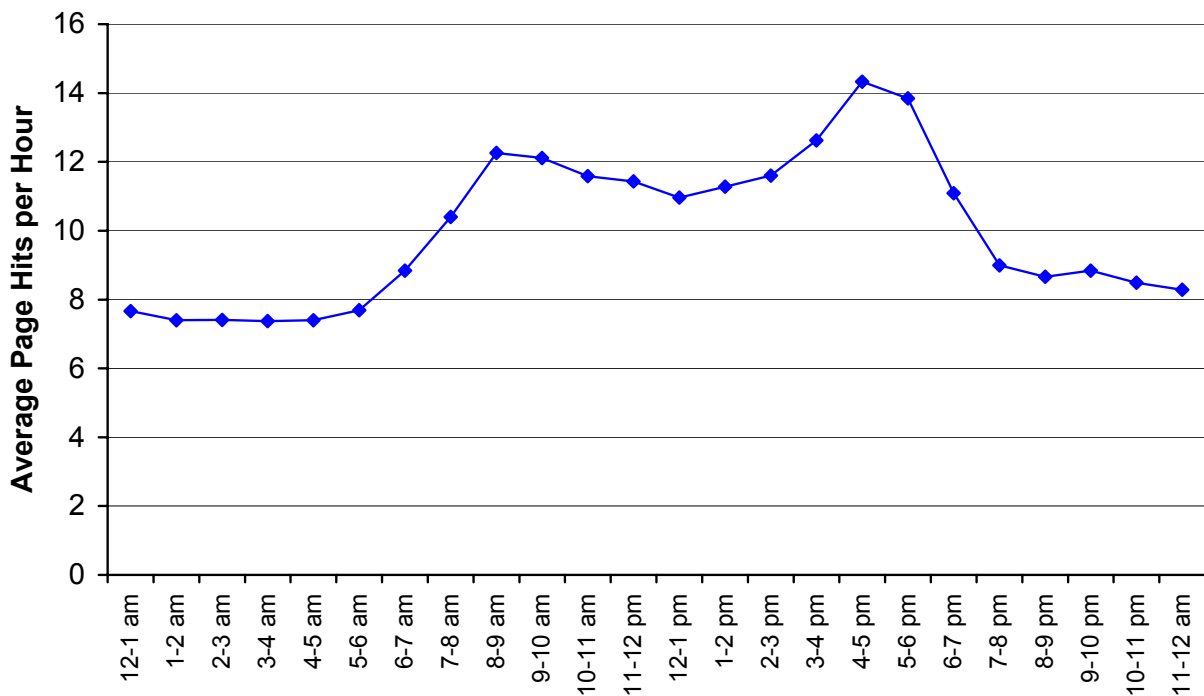**Exhibit 25 – TravelTIP Usage, by Day of Week**
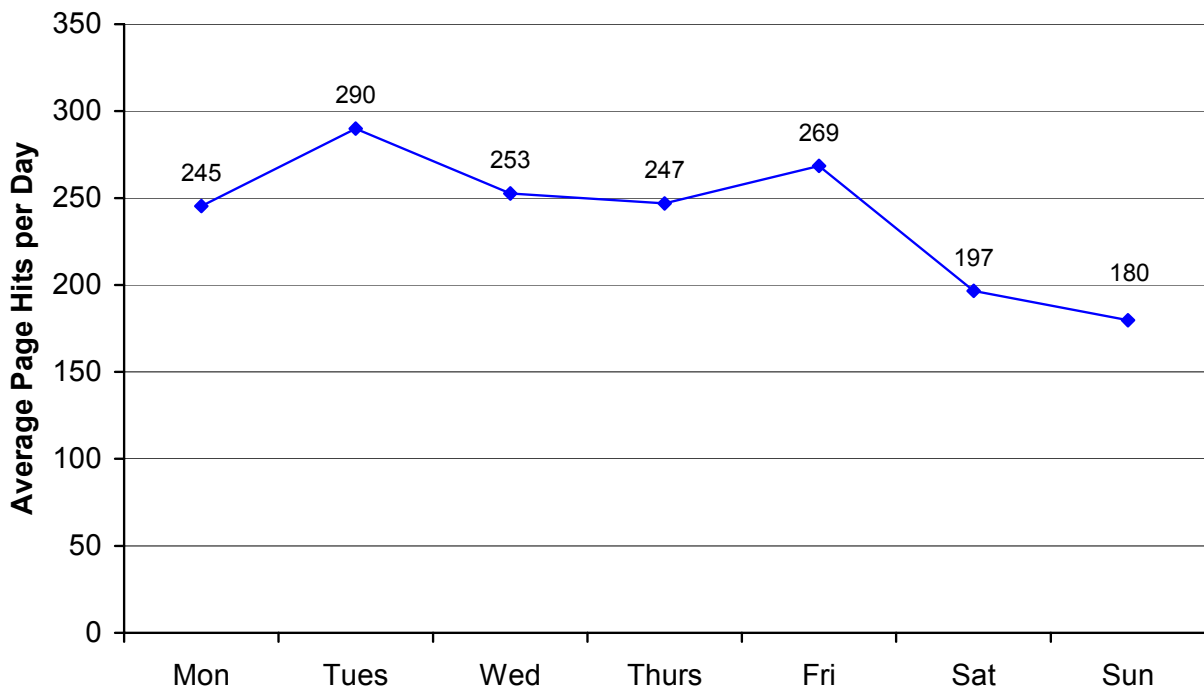
The relative proportions of Traffic page hits versus Transit page hits by day of week were not available.

The day of the week with the highest average usage was Tuesday, followed by Friday. However, it should be noted that June 12, the day after the media blitz, was on a Tuesday. If data for this particular day is removed from the calculation, the average daily number of page hits on Tuesdays was 263 – closer to the average for other weekdays.

The volume of page hits on Mondays through Fridays (average of 261 page hits per day) was about 38.5% higher than the volume on Saturdays and Sundays (average of 188 page hits per day).

Exhibit 26 shows the average hourly number of page hits to TravelTIP, by time of day.

Exhibit 26 – TravelTIP Usage, by Time of Day

The relative proportions of Traffic page hits versus Transit page hits by time of day were not available. Different time of day distribution data by day of week was also not available.

The peak times were from 8 am to 10 am in the mornings (average of 12.2 page hits per hour), and from 3 pm to 6 pm in the afternoons (average of 13.6 page hits per hour). Usage was fairly constant from 10 am to 3 pm (average of 11.4 page hits per hour).

Only summary data regarding the usage of the HAT is available at this time. The system received roughly 900 calls per month.

Exhibit 27 compares the average daily use of the TravelTIP website and HAT during the eight-month period from June 2001 to January 2002 to that of Smart Traveler and CHIN, two other California-based traveler information systems.

Exhibit 27 – Summary Comparison

System	Average Daily Website Hits (Home Page)	Average Daily Number of Calls
TravelTIP	241	30
Smart Traveler	81	6,250
CHIN	4,029	8,341

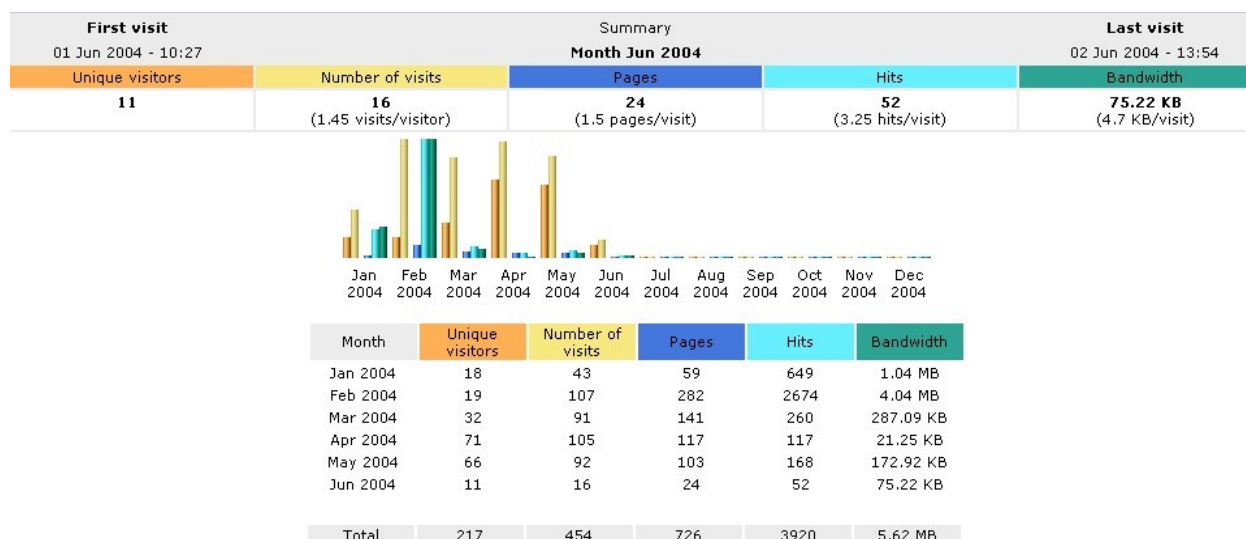Exhibit 27 does not highlight that use of the TravelTIP website went down significantly after July 2001:

‣ From June 2001 to July 2001, there were an estimated 439 average daily home page hits to the TravelTIP website;

‣ From August 2001 to January 2002, this number went down to 191.

CHIN is clearly the most heavily used of the three systems. Reasons for variations in use among the three systems are likely to include:

‣ Time in Market – Smart Traveler and CHIN have been operational for several years and have had an opportunity to establish a user base. TravelTIP is relatively new.

‣ System Functionalities – The Smart Traveler website is primarily a portal to other regional traveler information services, while the CHIN website provides a textual listing of current traffic incidents, closures, etc.

‣ Geographic Coverage – TravelTIP focuses on the Orange County region, while both Smart Traveler and CHIN are statewide.

Data on the public's use of the Mode Shift website is available for the system's four months of operation immediately following completion of acceptance testing in February 2004, as shown in Exhibit 28. The usage data is drawn from automatically collected server statistics and is based on the number of web pages requested. These statistics provide both the number of unique users and the number of distinct user sessions.   Mode Shift's traffic map refreshes automatically approximately every 60 seconds, and each refreshed page is counted as a new page request or "hit." In the month of March 2004, for example, Mode Shift received 260 hits and had 32 unique visitors.

Exhibit 28 – Mode Shift Website Usage, by Month

First visit		Summary		Last visit
01 Jun 2004 - 10:27		Month Jun 2004		02 Jun 2004 - 13:54

Unique visitors	Number of visits	Pages	Hits	Bandwidth
11	16 (1.45 visits/visitor)	24 (1.5 pages/visit)	52 (3.25 hits/visit)	75.22 KB (4.7 KB/visit)

Month	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Jan 2004	18	43	59	649	1.04 MB
Feb 2004	19	107	282	2674	4.04 MB
Mar 2004	32	91	141	260	287.09 KB
Apr 2004	71	105	117	117	21.25 KB
May 2004	66	92	103	168	172.92 KB
Jun 2004	11	16	24	52	75.22 KB
Total	217	454	726	3920	5.62 MB

The average hits-per-month to Mode Shift's traffic page was 653 between January and June 2004. The low usage reflects the fact that most of the visits are from individuals who were affiliated with the Mode Shift project, and who repeatedly visited Mode Shift during the pre-acceptance and post-acceptance phase to assess functionality. In the month of May 2004, Mode Shift averaged 2.86 unique visits per day.

By comparison, TANN has been incredibly successful in increasing the distribution of traveler information by providing it to established media outlets such as television stations and local area news websites. TANN reports that "page views" of its maps reached 3 million per month (nationwide, but mostly in Southern California) by early 2004. This was aided a great deal by its partnership with the ABC television affiliate in Los Angeles.

6.6 Transportation System Impacts

For several of the Showcase projects, an evaluation of transportation system impacts was deemed unwarranted due to observed low or insignificant usage of the deployed ITS. It was not feasible to measure their impact on travel adjustments (by time of day and route), mode shifts, traffic safety, or air quality in a comprehensive and scientifically robust cost/benefit manner because they had not sufficiently penetrated the traveler information marketplace. In short, for most of the systems, it is too early to tell what the impacts might be. These treatments must be given more time to work. A more thorough impacts analysis of these systems might be warranted once greater usage is achieved.

In the remaining cases, trends in transportation system performance were extrapolated from survey responses or calculated using archived data from California's Highway Performance Measurement System (PeMS), which is the result of a joint effort between Caltrans and the Partnership for Advanced Transit and Highways (PATH) at UC-Berkeley. PeMS collects, validates, and archives incident statistics and real-time loop detector data for highways around the state, as well as provides access to various analytical tools via a web-enabled interface. The evaluation looked for changes in transportation system performance by looking at data from before and after the various Showcase systems became operational. However, because Showcase is deployed in a "real-world" environment and is subject to many influences beyond the control of the evaluation, this report can neither show nor prove a direct or exclusive causal relationship between the Showcase systems and the trends observed. The reader should consider the Showcase systems to be among the many contributing factors that may have resulted in the observed trends.

6.6.1   Mode shift and intermodal impacts resulting from the Showcase Projects

During the Showcase Program, the Evaluation team worked in cooperation with the Volpe Center during a survey of ATIS users in the Los Angeles area. A relative minority of the survey respondents indicated that they would shift transportation modes if they learned of an incident impacting their typical route. For the morning commute *to* work or school, 6% indicated that they would change modes. This percentage drops to 4% for the afternoon commute home.

According to the Evaluation's TravelTIP survey, however, 10% of respondents reported having used public transit at least once as a result of learning of a traffic incident through TravelTIP. Extrapolating this percentage to all TravelTIP users, this might have resulted in as many as 960 people temporarily shifting to transit.

A larger number of TravelTIP survey respondents (15%) reported having ever switched from using transit to driving an automobile at least once as a result of TravelTIP. This may be indicative of several possible scenarios, including (but not limited to):

‣ Voluntary transit users (i.e., those who choose to use transit, but also have automobiles and do not necessarily depend on transit) who would rather sit in traffic in their own automobile versus aboard a bus.

‣ Voluntary transit users who choose to drive so as to depart at a different time or take an alternate route.

6.6.2   The safety-related impacts of the Showcase projects

Exhibit 29 shows that incident rates in all three regions (Los Angeles County, Orange County, and the Inland Empire) were relatively constant until the last half of 2003, at which point the average number of monthly incidents dropped. Since many of the Showcase systems were not operational during this period, the cause of the decrease is not known.

Exhibit 29 – Monthly Incidents on Southern California Highways
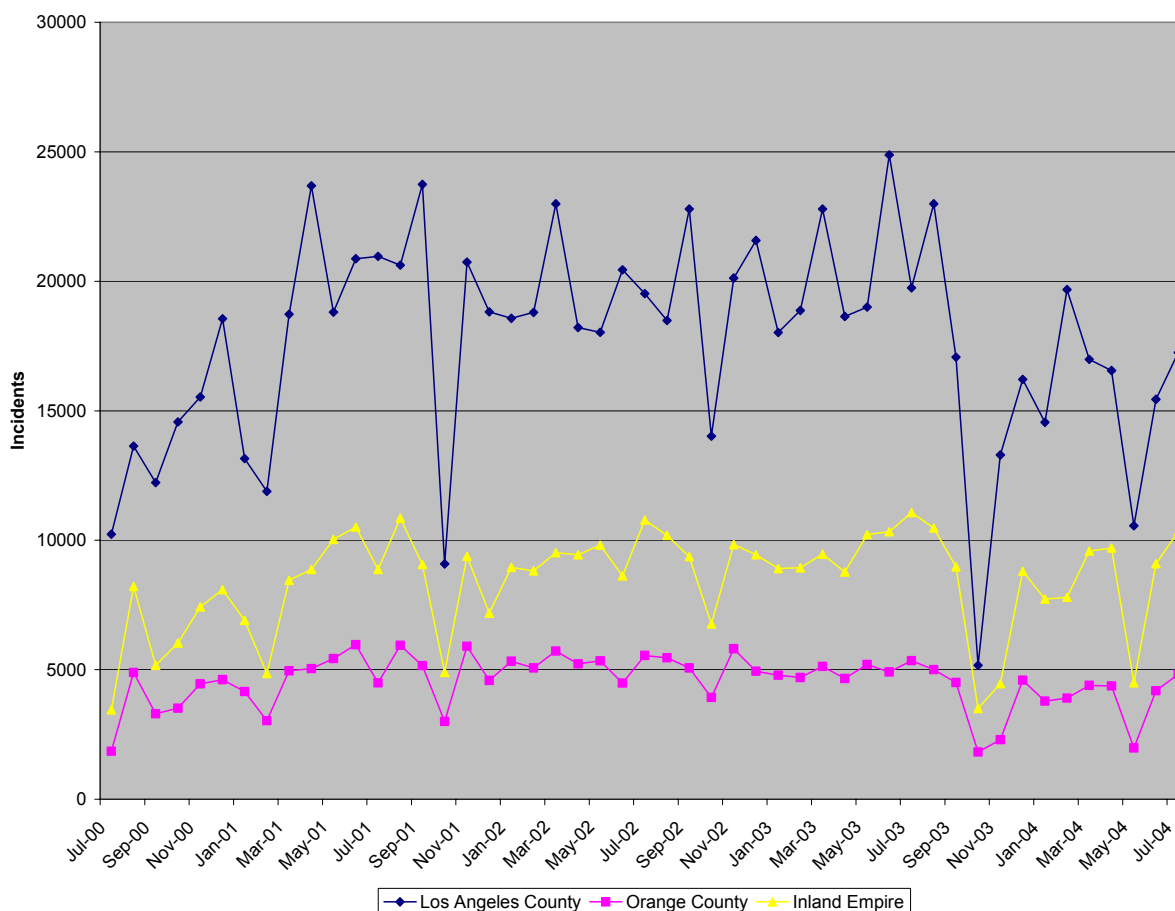
6.6.3   The impact of Showcase projects on traffic congestion

Although neither IMAJINE, LA/Ventura ATIS, nor Mode Shift currently get enough use to significantly impact overall traffic conditions, an analysis was conducted to study the possible impacts from TANN. PeMS traffic data from Los Angeles County, Orange County, and San Bernardino County were studied over the period of July 2000 through July 2004.

Exhibit 30 shows that overall freeway traffic conditions were relatively constant in Orange County and San Bernardino County until late 2002, at which time it improved markedly in both. Meanwhile, VMT/VHT in Los Angeles County has been gradually decreasing, which implies steadily growing delay in that region. However, some might argue that the delay would be even worse without the presence of traveler information services.

Exhibit 30 – Aggregate VMT/VHT for Freeways in Los Angeles County, Orange County, and San Bernardino County
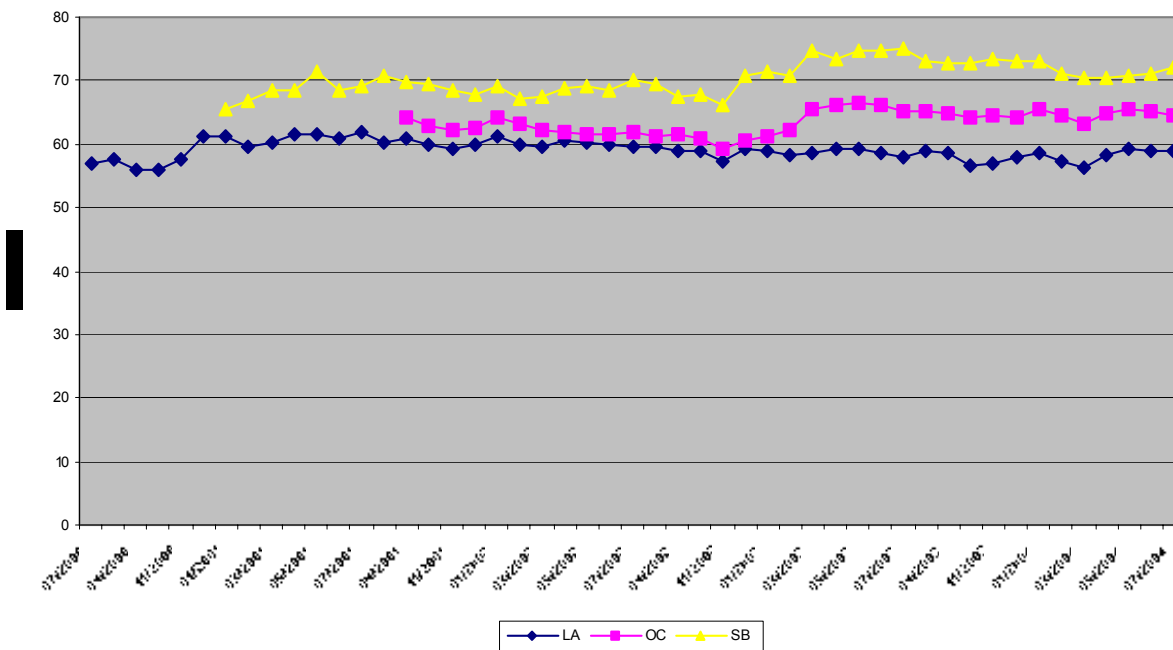
Since the City of Fontana represents only a small portion of San Bernardino County, data for Interstate 15 between post miles 106.7 – 115.5 were analyzed separately from other San Bernardino County data to investigate the impacts of the ATMIS. Exhibit 31 shows these results.

Exhibit 31 – Q (VMT/VHT) for I-15 near Fontana between Jan. 2002 and Aug. 2004
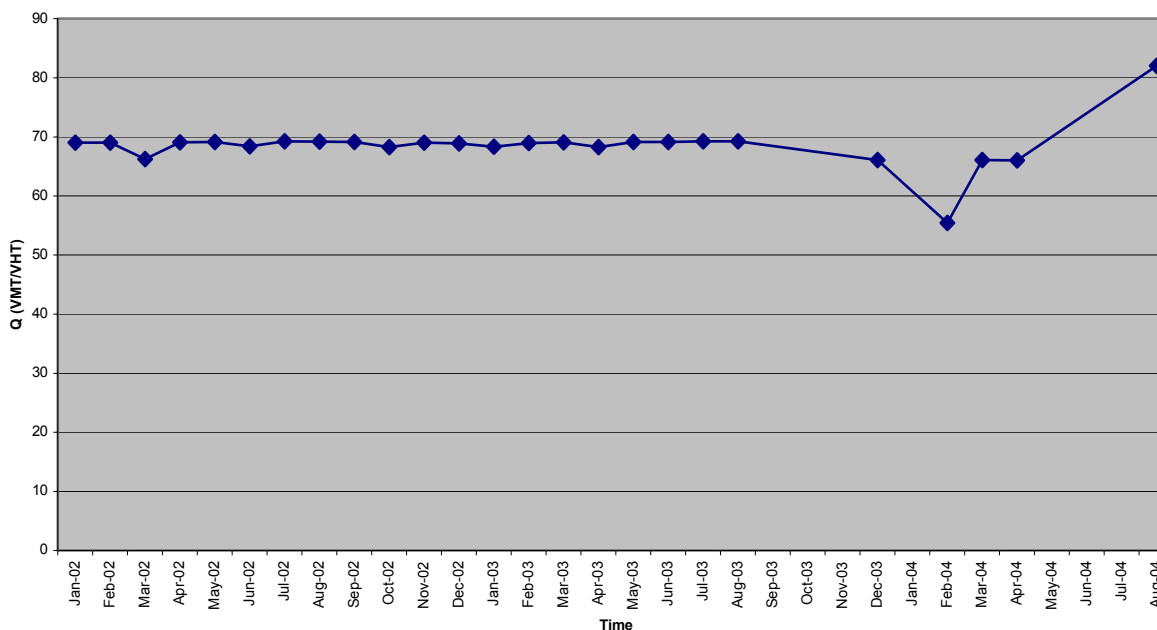
It is not clear why VMT/VHT dropped and then shot up so significantly in the past year. One interpretation of the data is that traffic might have slowed and then greatly improved due to the construction and subsequent opening of a new exit or an added freeway lane. As of the writing of this report, the evaluation is awaiting confirmation as to whether such construction took place during that time near this stretch of Interstate 15.

Although Interstate 10 also passes close to Fontana, there are no detectors in that vicinity (between post miles 57.61 – 65.56) on which to base an analysis.

Although it is impossible to show a direct correlation between TANN's traveler information and the observed trends shown above, the evaluation also cannot exclude it from among the many factors possibly influencing traffic conditions.

In a survey of TANN website users conducted by the Volpe Center in coordination with the Showcase Evaluation team, 66% reported a likeliness to change their departure time when learning of an incident before leaving home to go *to* work or school. A similar number of TANN survey respondents (67%) are also just as likely to take an alternate route. 19% would run errands or make stops that they otherwise would not have made, while 27% report that they would make no changes to their morning commute and travel as normal.

Behaviors during the afternoon commute *from* work/school back home follow a similar trend. 71% of respondents say they would change their departure time when learning of an incident. 70% would make minor route changes, while 60% would consider entirely different routes. As might be expected, respondents are more likely to run errands or make otherwise unplanned stops during the afternoon commute (33%) than during the morning commute (19%).

Perhaps more revealing, 87% of TANN survey respondents reported that traffic information has saved them time, and 78% report that the traffic information has helped them avoid traffic problems.

Based on the traveler information website usage statistics, survey results and PeMS data, the Evaluation believes that, at this time, traveler information seems to benefit only a relatively small number of commuters who are exceptionally motivated to actively seek out traveler information sources. However, the number of such commuters is generally too small to have any significant impact on overall, network-wide traffic conditions.

6.6.4   The environmental impacts of the Showcase projects

Due to currently low utilization of the Showcase systems, an empirical analysis to detect their impacts on air quality and the environment was not performed. As a result, this report can only theorize about the potential impacts that traveler information might have on automobile emissions and air quality. These benefits are described in general below. Since there are virtually endless scenarios to consider, the reader is invited to use the information provided to quantify his or her own specific benefits.

**Anticipated Air Quality/Emissions Benefits of Using Traveler Information**

Mitigating Action	Benefit
Change Departure Time	Enables vehicle to travel at higher speed by picking a time when congestion is less severe. Consider a scenario in which an "average" vehicle typically travels 30 miles between home and work, with 7 miles of travel on local streets at 35MPH and 23 miles of travel on freeways at 65MPH. On a typical day, CO output from this trip might be roughly 434.3 grams. However, a one-mile delay (travel at 2.5MPH) on the arterial portion of the trip would inflate the total CO production to 508.08 grams, while a one-mile delay on the freeway portion would result in the production of 501.98 grams. Under this scenario, each vehicle that avoids the traffic congestion could avoid producing as much as 17% greater CO emissions.
Cancel Trip	At best, canceling the trip means that no emissions are generated. At worst, the emissions that would have been generated during the trip are simply deferred to another time.
Take Alternate Route	Since the amount of CO produced at idle is so much more than that produced at higher vehicle speeds, a vehicle could take an alternate route that is longer than the normal route taken and still produce less total exhaust emissions in the process. Using the scenario above, this vehicle could travel up to twice as far on an alternate set of arterials, or roughly 20% farther on an alternate set of freeways.
Take Transit/Carpool	One less vehicle on the road means that much fewer emissions generated. The fewer the vehicles on the road, the higher the travel speeds, which can also reduce emissions further.

6.6.5   The impact of Showcase projects on transit operations

As shown in Exhibit 36, overall ridership on Los Angeles MTA buses and light rail decreased between fiscal years 1988 to 1995, despite the opening of the Blue Line and Red Line in the early 1990's. The trend reversed in the second half of the 1990's, aided somewhat by the opening of the Green Line, and overall ridership has generally been on the rise into 2003. This year's opening of the MTA's Gold Line will likely help maintain that growing trend.

These changes are not believed to be related to IMAJINE, LA/Ventura ATIS, Modeshift, or TANN. IMAJINE's traffic signal priority feature will help improve transit speeds and on-time performance only after the AVL system has been installed. LA/Ventura ATIS is not yet available to the public, and Mode Shift's initial deployment is restricted to a relatively small geographic area. TANN does not currently provide transit route or schedule data, and relatively few of the User Survey respondents indicated a likelihood to shift modes as a result of traffic data received through the TANN website.

These findings do not mean that more significant impact might not be experienced later in the future as Southern California's population continues to grow, traffic conditions worsen, and more commuters make use of the available traveler information. In short, it is too early to tell, and a longer-term study involving more extensive user surveys would be required to draw definitive conclusions.

Exhibit 32 – Annual Ridership in Millions on MTA Bus and Rail Lines
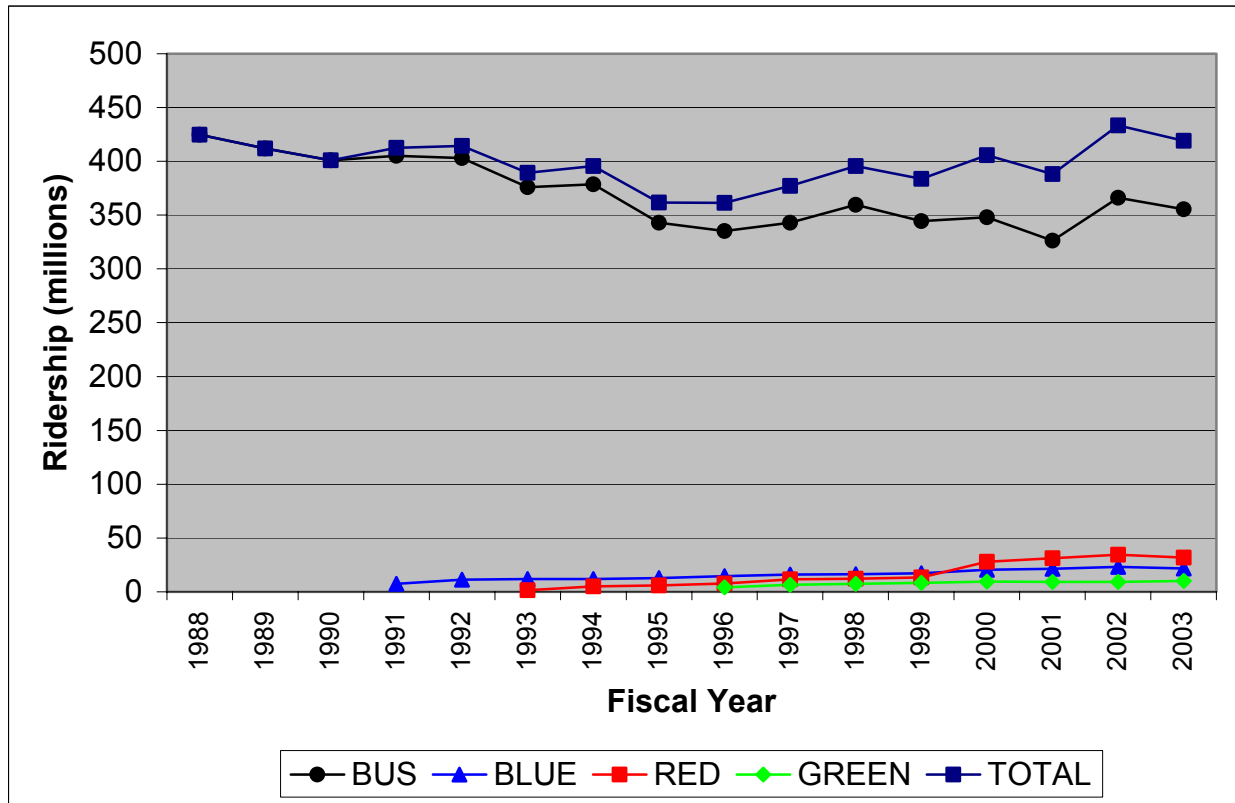
Data collected during the TravelTIP online survey indicates that much fewer users visited the site for transit information than for traffic information. Of the survey's 170 respondents, 40 (or 24%) reported using TravelTIP's transit page as compared to the 169 (99%) who reported using the traffic page. One reason for this may be because TravelTIP's transit page simply provides links to existing route and schedule information on other websites (an economical approach that avoided "reinventing the wheel"). Users interested only in transit information can simply "bookmark" those other sites and return to them directly without having to go through TravelTIP.

Conclusions

The Showcase Program is a very ambitious undertaking, and is only one part of Southern California's ongoing effort to develop and deploy an integrated ITS infrastructure. The Showcase Program has provided Southern California's four regions with a common foundation on which to continue those ITS developments.

Although the goal of the Showcase Program was to develop an integrated, Corridor-wide "system of systems," a number of institutional, programmatic and technical issues have delayed the realization of that goal.

Custom software development is inherently risky and often unpredictable, and a program manager's first priority should always be to reduce the risk as much as possible. Risk mitigation can be aided through a number of steps:

▶ Project teams should develop a detailed Concept of Operations (ConOps) in order to define agency roles and responsibilities; uncover any institutional, operational, or financial issues upfront; and help create a common vision of the project's end product.

▶ Proceed in small, incremental, and iterative steps. Software products must be allowed to evolve as needs and technology change. This can be accomplished by starting small and gradually adding features or making changes to the system over time. Development of a software system should not be considered a one-time endeavor, but rather an ongoing effort.

▶ Perhaps utilize a task order contract arrangement so that the direction of the project can be reevaluated at specific milestones.

Such a large and complex program would have benefited greatly from the presence of a single, unbiased, high-level system integrator or Systems Engineering & Technical Analysis (SETA) consultant to assist with program management and coordination of the individual projects. While some of the tasks that would have been performed by such a consultant were undertaken by the Steering Committee, agency staff, and the project teams, these efforts were fragmented and there was no single entity to bring it all together.

The absence of a SETA consultant to collect, organize and validate system documentation from the individual projects may have also permitted allegations of discrepancies with some interface specifications to go unresolved. A task to collect, organize and validate system documentation from the individual projects is still recommended.

However, the obsolescence of one of Showcase's third-party CORBA software components could not be predicted or avoided. Although the Showcase Network's Kernels were successfully completed and installed, the unforeseen obsolescence and lack of backwards compatibility of Iona's ORB software products resulted in several regional Showcase systems not being able to integrate to the Corridor-wide network. The Priority Corridor is currently investigating alternative approaches and technologies.

The Southern California Priority Corridor has learned and accomplished a tremendous amount in the past ten years. In the short- to mid-term, the four regions of the Southern California Priority Corridor are pursuing the development of their own separate regional ITS networks, each based upon the Showcase Architecture. These regional ITS networks provide for local integration and coordination, and, in time, may be linked via an inter-regional backbone to ultimately achieve the Corridor-wide vision.

Endnotes/References

[1] ISTEA requires that "operational tests utilizing federal funds have a written evaluation of the Intelligent Vehicle Highway Systems technologies investigated and the results of the investigation." Although Showcase is not officially an operational test, it deploys and demonstrates ITS services, functions, and technologies under "real world" conditions, similar to an operational test.

[2] California Statistical Abstract, Table B-4. California Department of Finance, Sacramento, CA. December 2003.

[3] California Statistical Abstract, Table J-4. California Department of Finance, Sacramento, CA. December 2003.

[4] "Implementation of the National Intelligent Transportation Systems Program – A Report to Congress 1994-1995", Appendix VI.

[5] "Implementation of the National ITS Program – 1996 Report to Congress", Appendix D, pp. 5-6.

[6] Showcase Completion White Paper, Caltrans, July 2002.